

GRANNIS

Possibilities of High School  
Agriculture under glass

Agriculture

B. S.

1910

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Class

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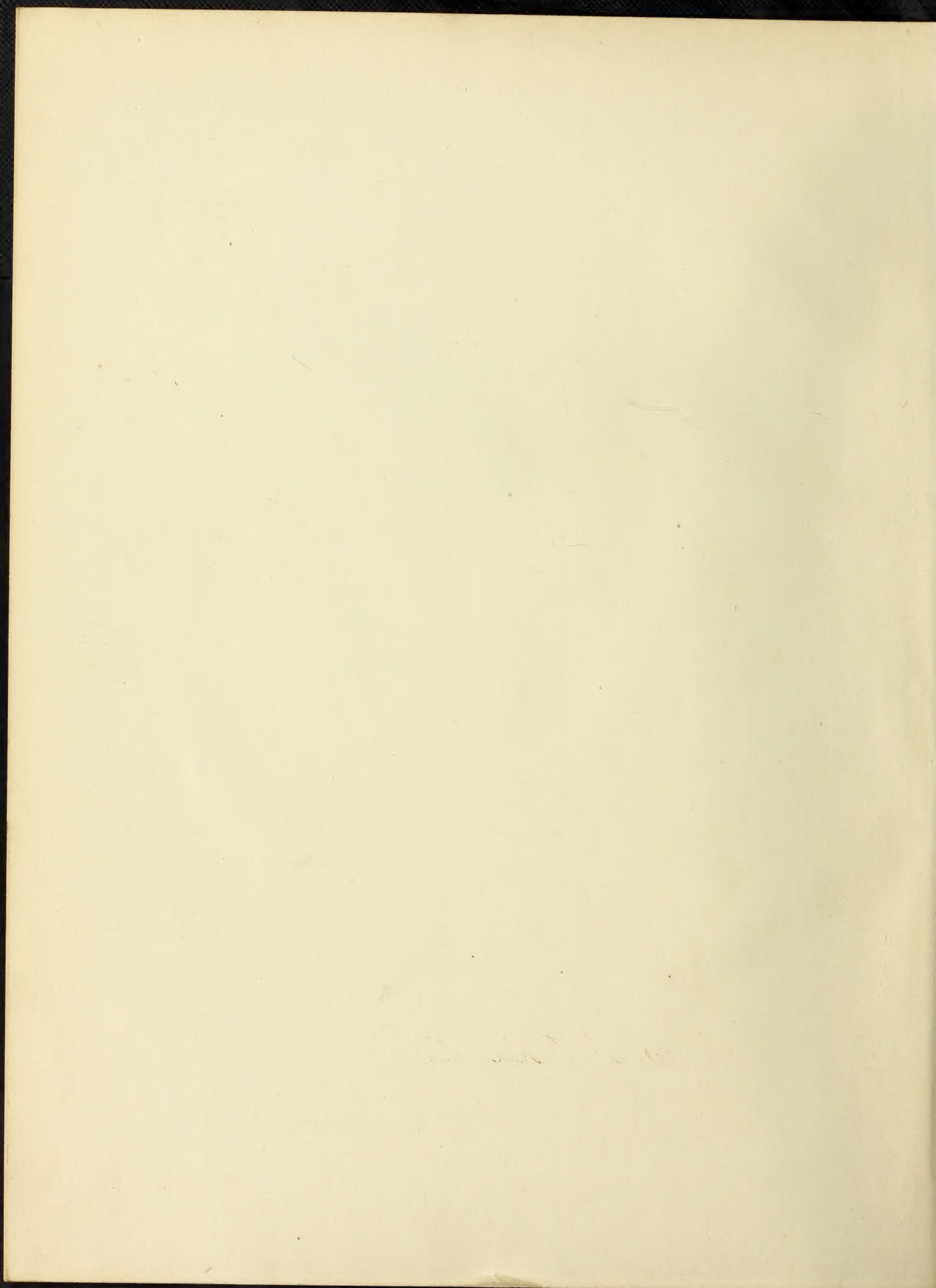
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Volume

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June 1<sup>st</sup> 1900.

THIS IS TO CERTIFY THAT THE THESIS PREPARED UNDER MY SUPERVISION BY

Frank Cravens Grannis,

ENTITLED Possibilities of High School  
Agriculture under Glass

IS APPROVED BY ME AS FULFILLING THIS PART OF THE REQUIREMENTS FOR THE

DEGREE OF Bachelor of Science.

S. O. Barto,

Instructor in Charge

APPROVED: Fred H. Rankin,

HEAD OF DEPARTMENT OF Agricultural Extension

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*Thesis.*

*Possibilities of High School*

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*Under Glass.*

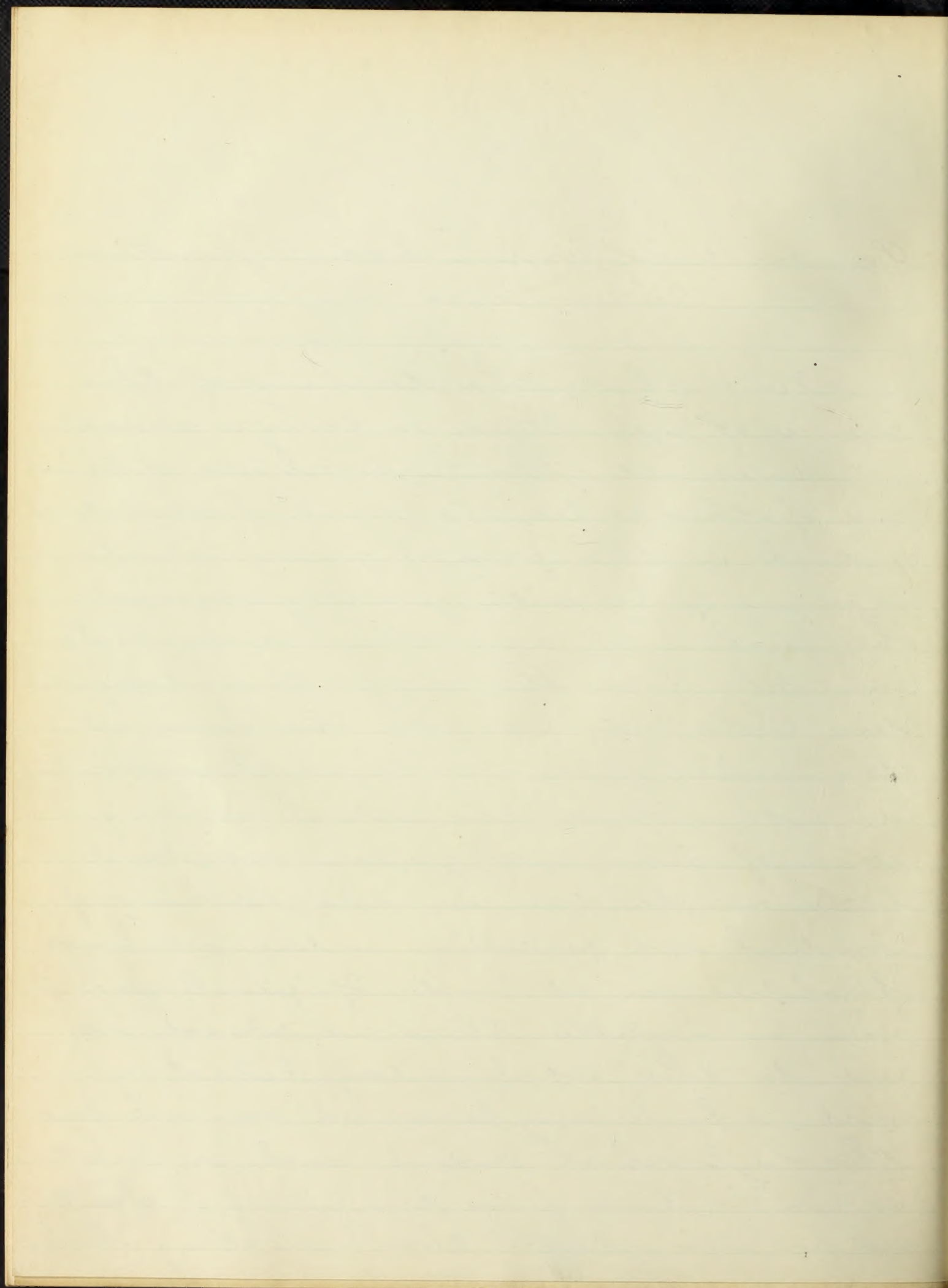
*by*  
*Frank Craven Grannis.*

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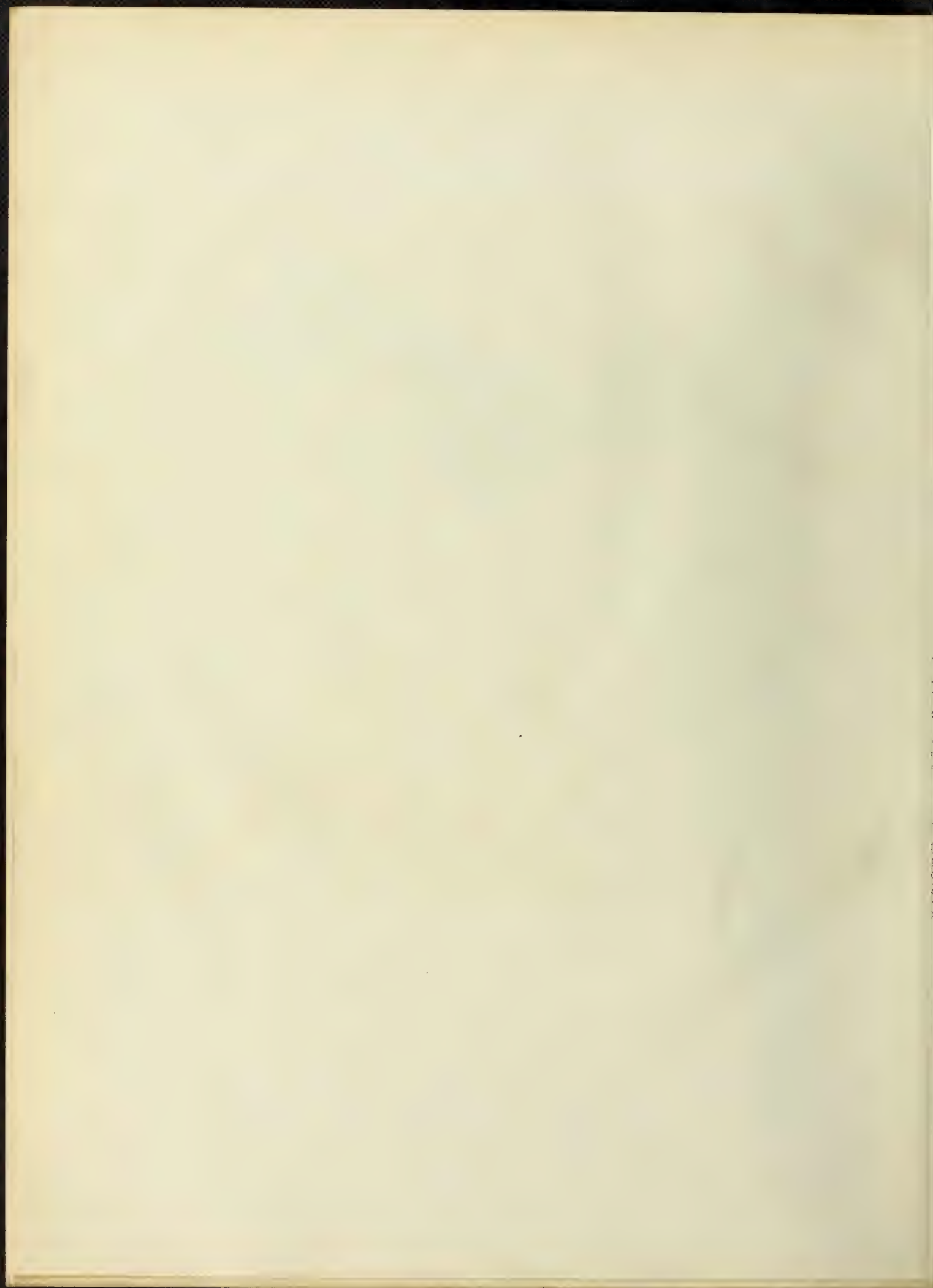
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## Possibilities of High School Agriculture Under Glass.

Now that the teaching of the science of agriculture is being so generally introduced into the high-schools of this and of other states, the want of illustrative material in the form of growing plants is coming to be pretty generally recognized. The teaching of agriculture is prone to come only from the meagre elementary text books now in use. The nine or ten months given over to school work do not include the actual growing season of farm and garden crops, and little can be done in the teaching of practical crop production unless greenhouse facilities are at hand. If greenhouse room is available there is almost no end to the supplementary laboratory work which may be carried on, and for the high-school student such demonstrations as can be had from the growing of plants are far more valuable than anything which



be testable in explicit super/exp.





Aug 1

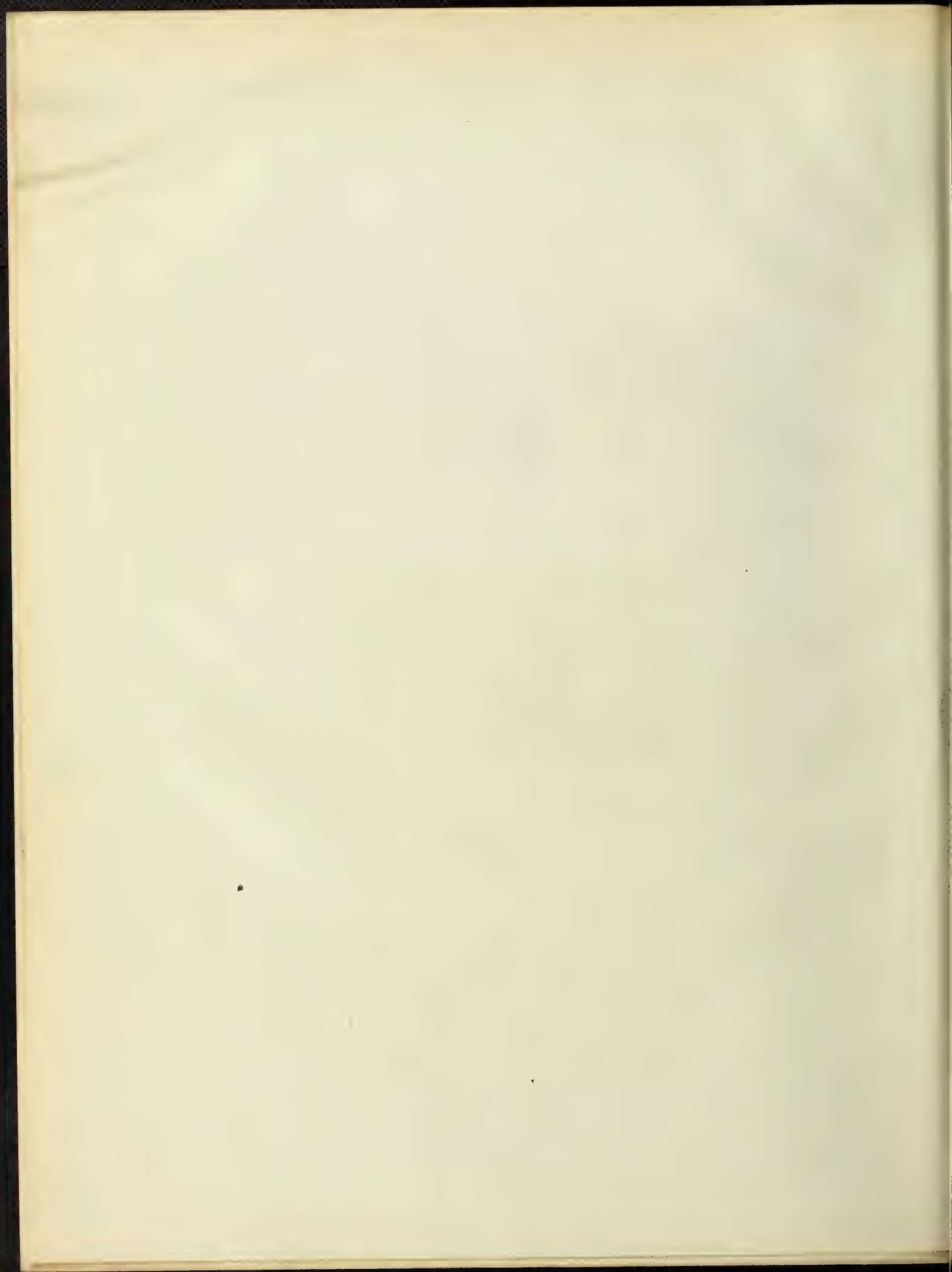
Sh. y. melons of high school purchased  
 in June. The 1st crop was made  
 started. In the 2nd crop the 1st set  
 has setts in the seed so the 2nd, in the  
 larger part a fertility test of the 1st set  
 and some other seed of the 1st set. The 2nd set  
 with leaves and plenty seed for use if needed.





Fig. 2

Interior of new house showing "Kubrick" roofing  
 used for siding, the whole interior is covered in  
 glass and the whole paper covers the rest  
 of the interior. After a while it would  
 be a good idea to have the whole  
 house covered in for best results. The  
 "Kubrick" roofing makes the house quite  
 tight and kept out the cold and wet.



Botanical instruction. The school has been exceedingly successful in its work at any high school could wish. The expense incurred is really less than that of the other schools for the patrons of the school.

It is an interesting note that the Virginia College of Agriculture, the first school of its kind in the State, is located here.



CLASS IN GREENHOUSE



These little feet long served.

for all work given for school.

undoubtedly I, early weeks and

showing the illustration of the school for additional material. The school is doing a fine work in the forcing of early vegetables and the time now for planting, and so on.

construction of the greenhouse illustrated. It is 30 feet wide and 20 feet high. It is a very simple structure, and is very well adapted for the purpose of raising early vegetables.

Spring the first of the year is now for the first time. The school is doing a fine work in the forcing of early vegetables and the time now for planting, and so on.

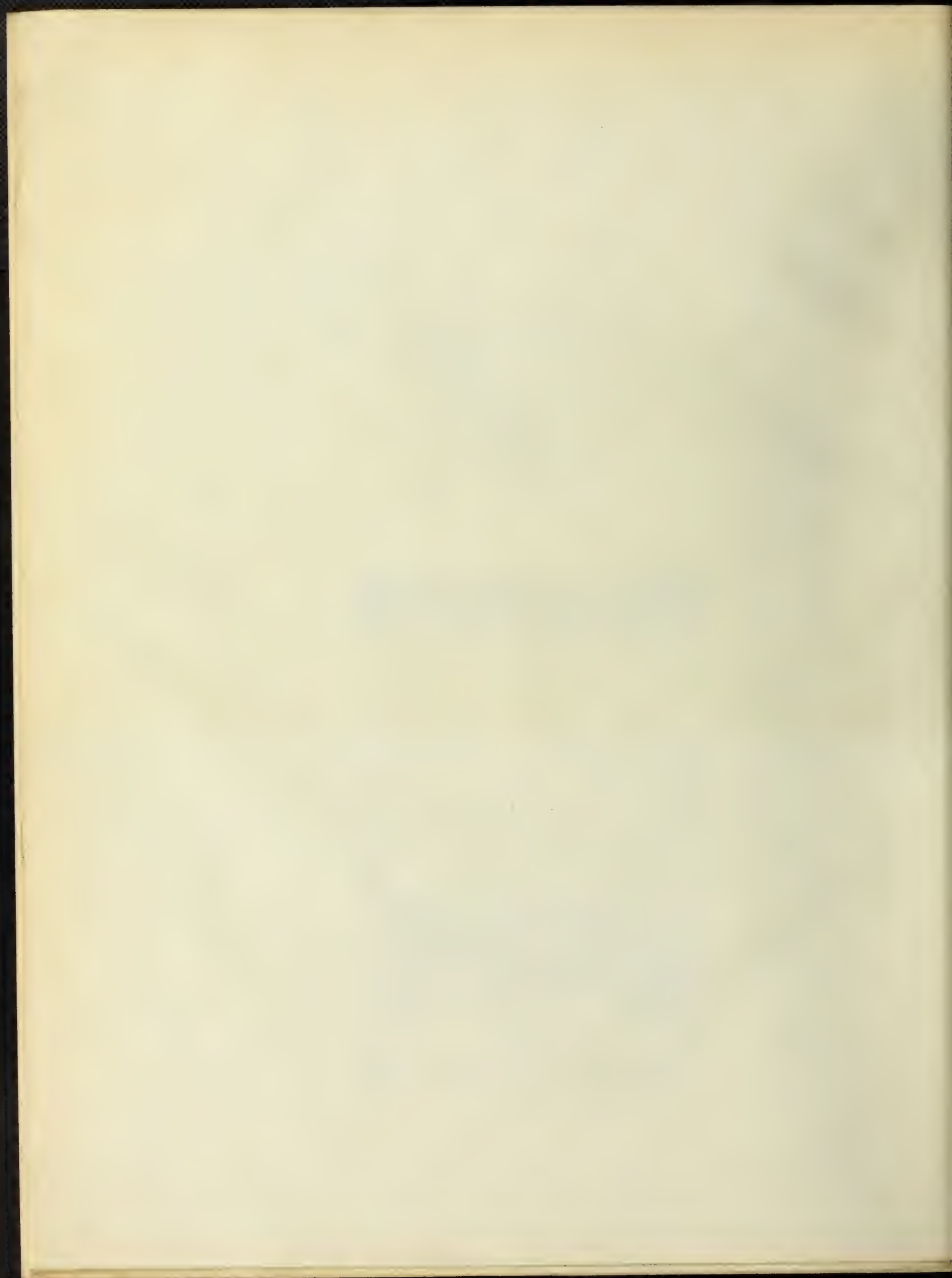
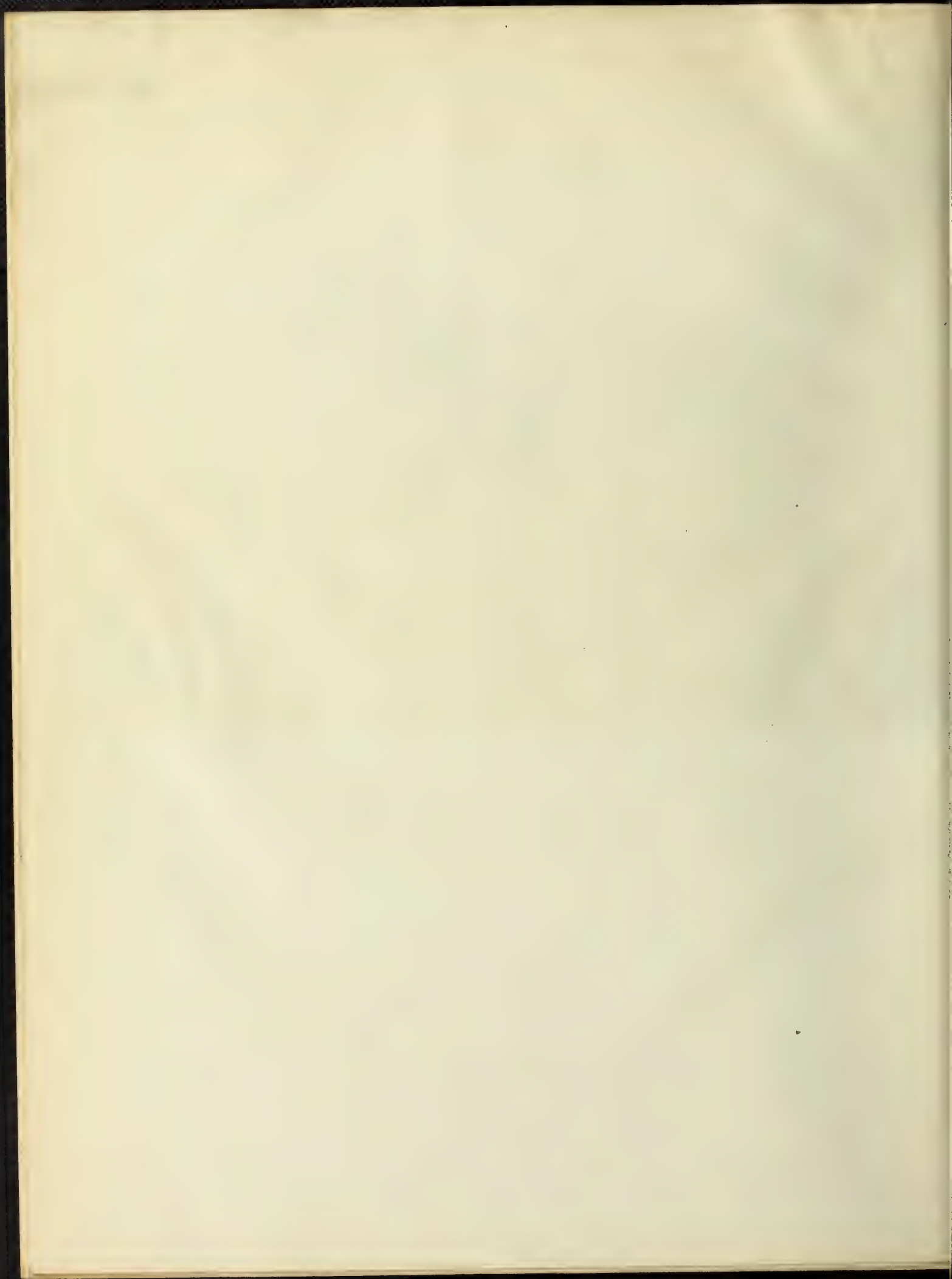




Fig. 4-

The second week the class in Gardens  
 crops in the shade of the vicinity  
 of Illinois was given instruction in  
 methods of planting and transplanting  
 of potted plants, and in the case of  
 greenhouse crops. It is possible for the  
 eight members of the class with their  
 teacher, to work together in the  
 little greenhouse. For large classes the  
 greenhouse would not be suitable, and  
 the plants could be taken into a larger room.



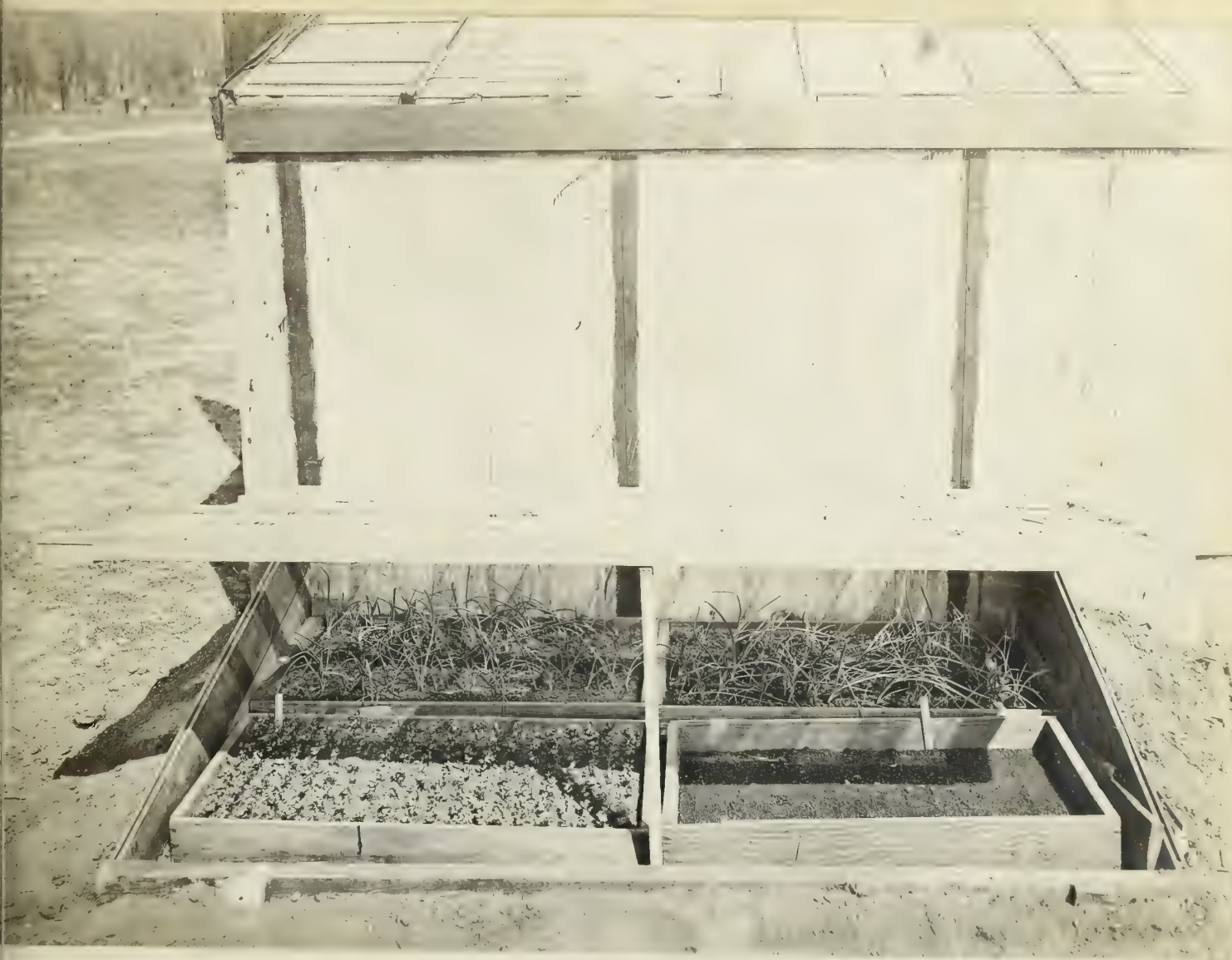
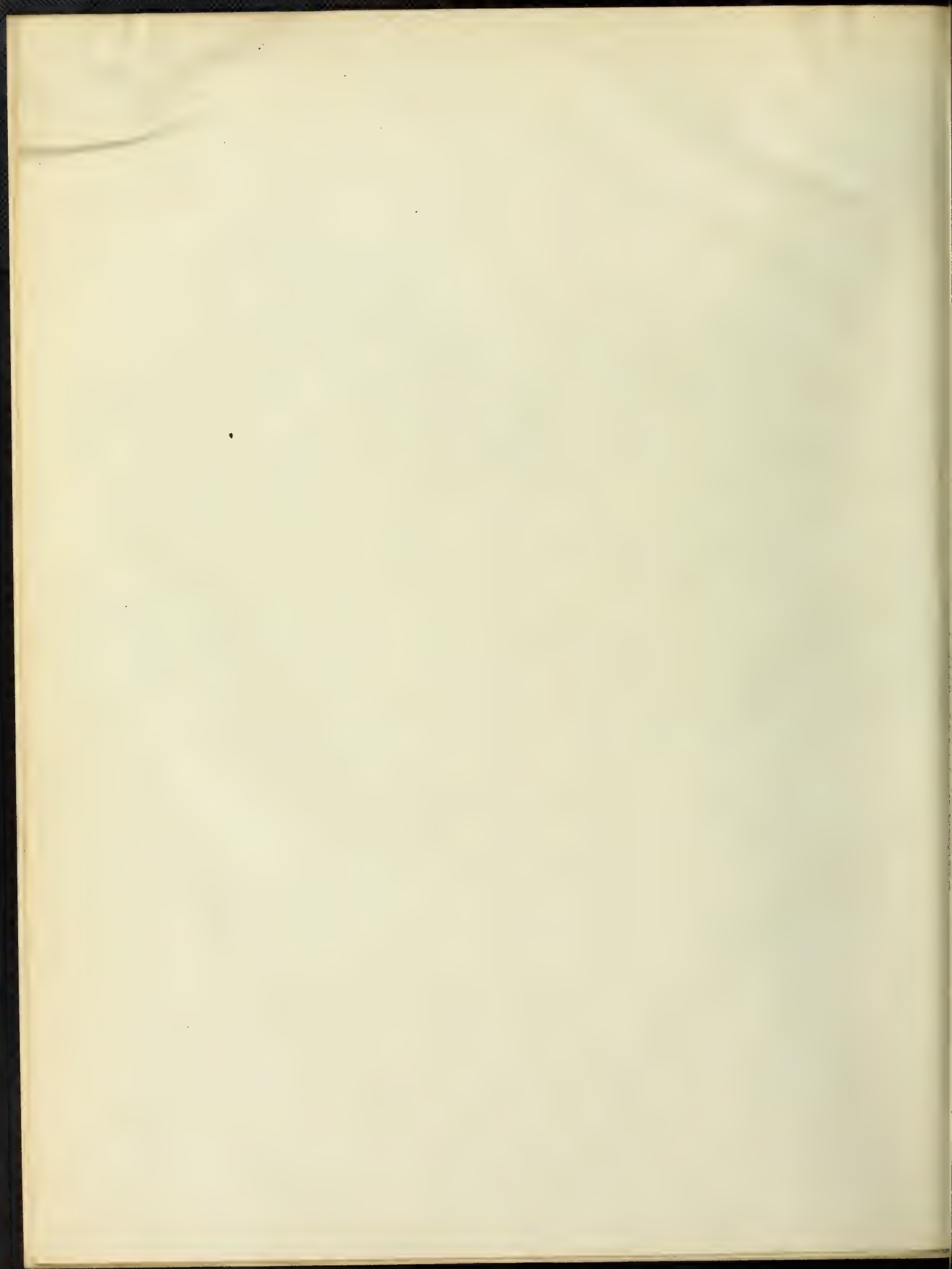


Fig. 5.

This cold frame, and a narrow hot-bed of similar construction were built by the Academy class in Garden Strip (Fig. 4). The cold frame contains lettuce, cabbage and onion seedlings "put off" and is intended for the cultivation of spring crops. This same frame served later as a protection for early tomatoes. It has a south slope, one sash frame being sufficient to cover the entire bed.

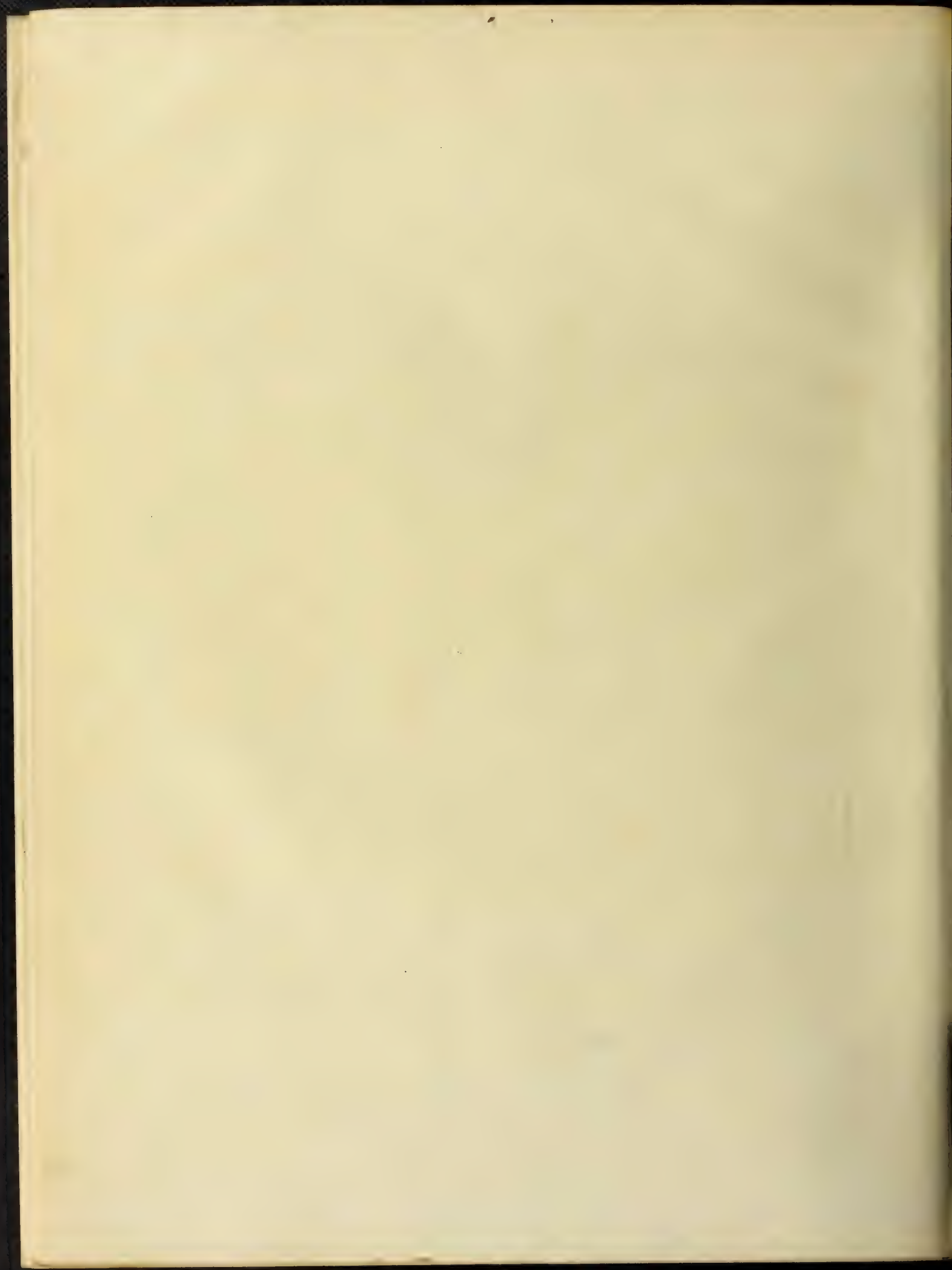


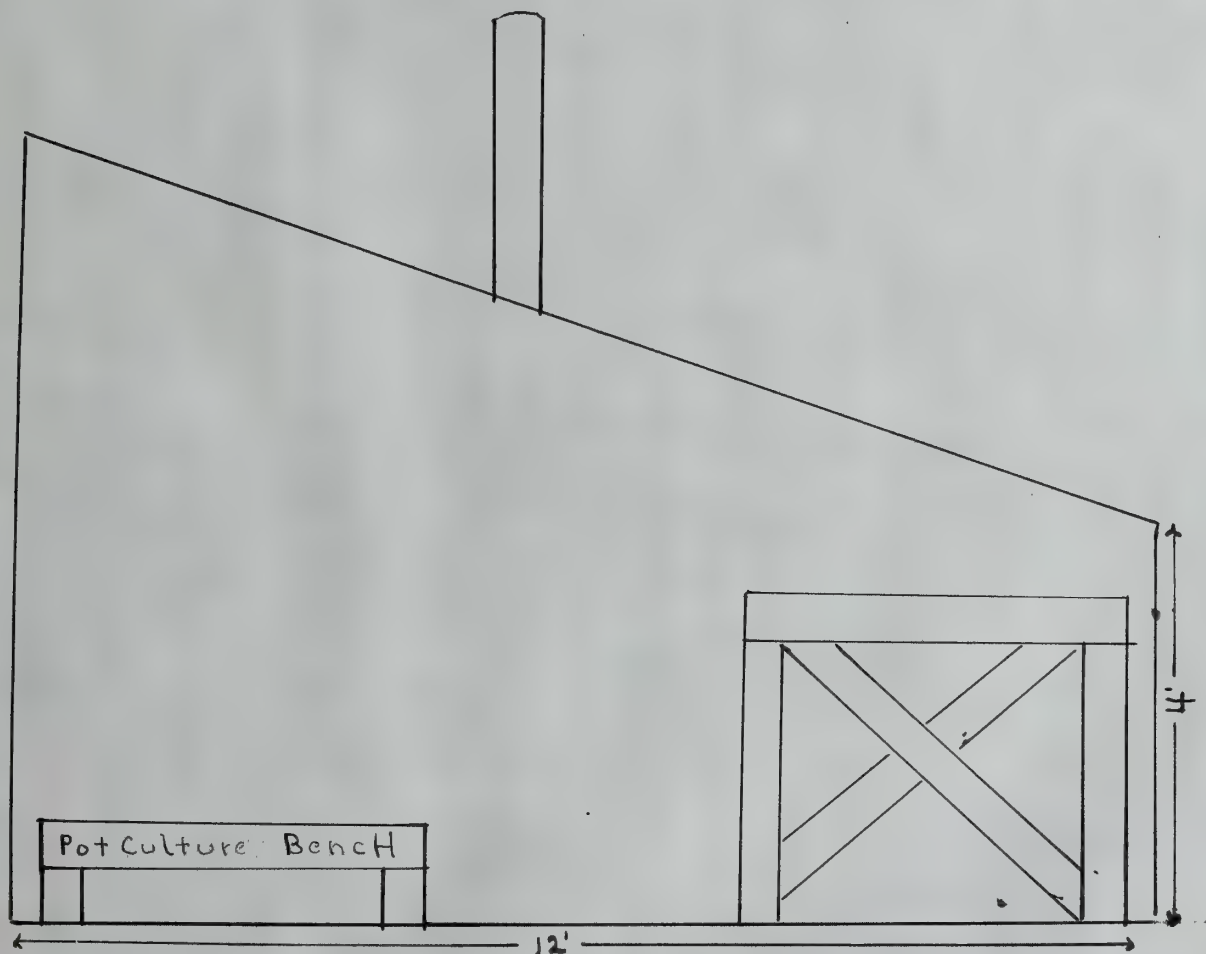
### Explanation of Plans.

The greenhouse is 10 feet long by 12 feet wide, eight feet high on the north side and four feet high on the south side. Cedar posts 10 feet long were set two feet in the ground on the north side and 6 foot cedar posts were set two feet in the ground on the south side. Ten foot cedar posts were set on the east and west ends leaving room for a door on the west end. Two by four pieces were laid along the top of the posts and upon them rested the rafters which were supported midway by a 2 x 4 piece.

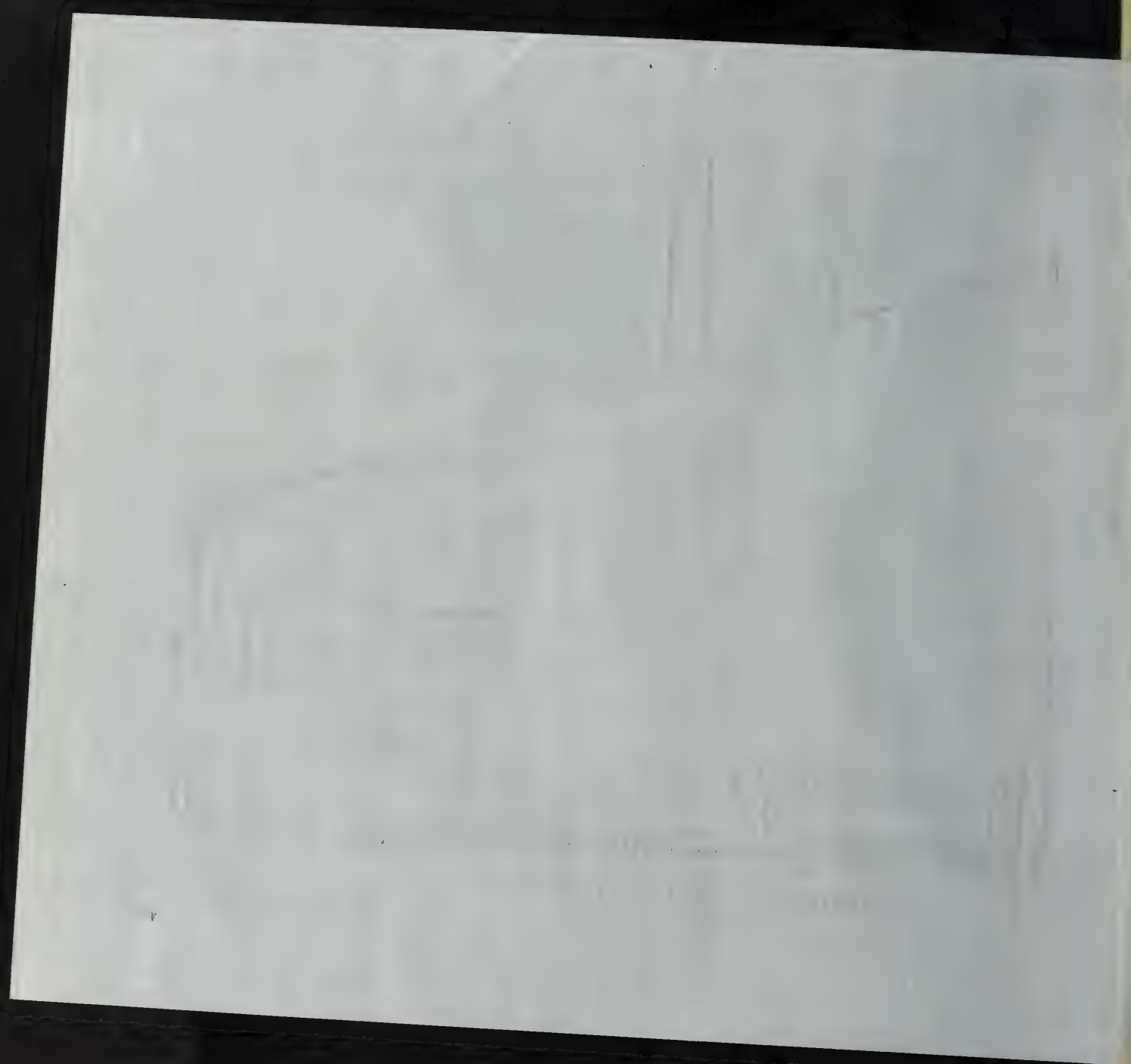
Old packing boxes furnished the siding. The pieces were nailed to the cedar posts and covered with the rubber-oil paper. The rafters were put up, one at a time and glass filled before the iron put in place.

The door opened outwards and was secured by a latch and padlock.





Side Elevation.



91'

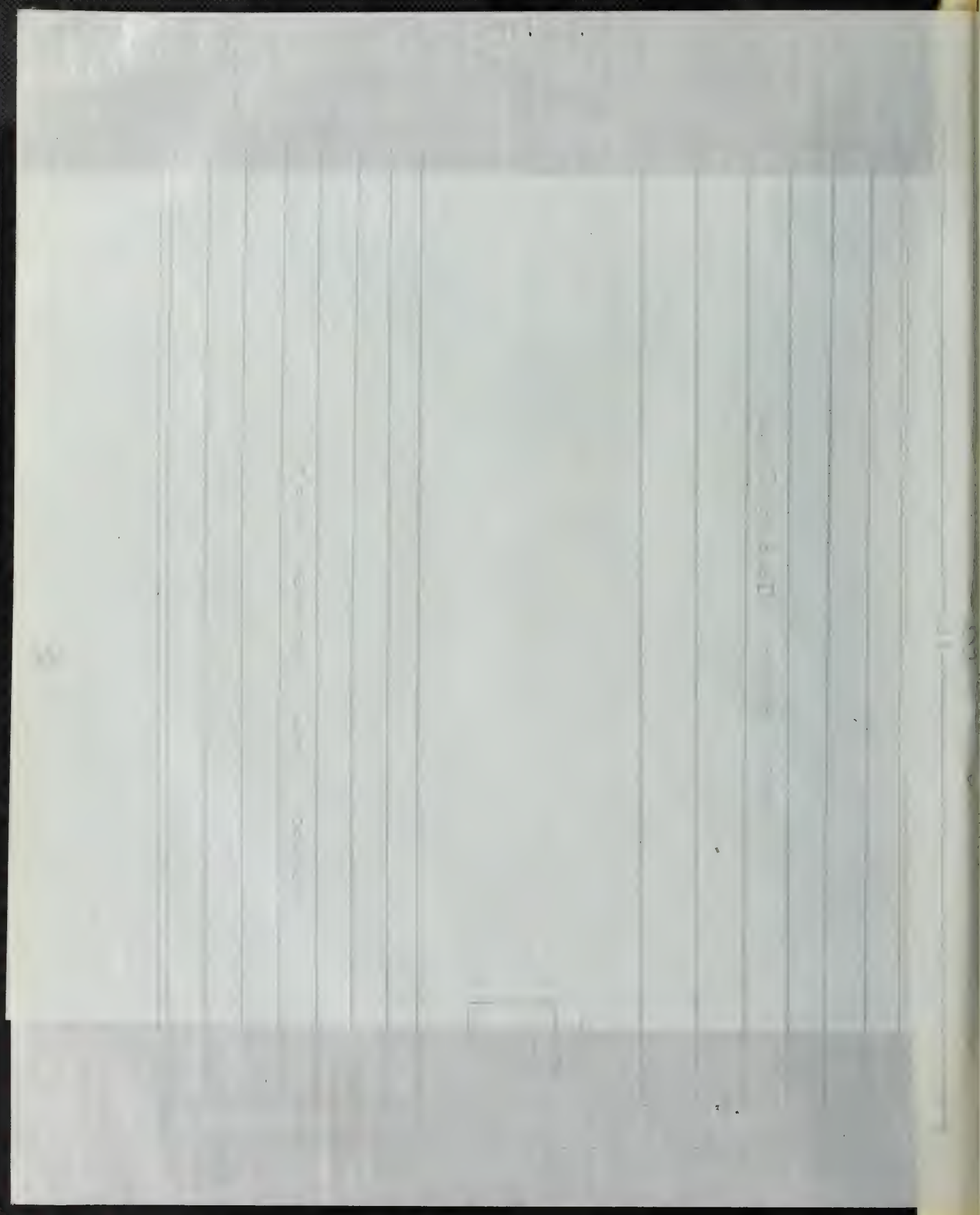
HIGH BENCH - Garden Crops -

LOW BENCH FOR cereals.

Stove

12'

N



Material used in the construction of  
the greenhouse.

The following items were purchased  
from a lumber yard in Williams-  
port, Pa.

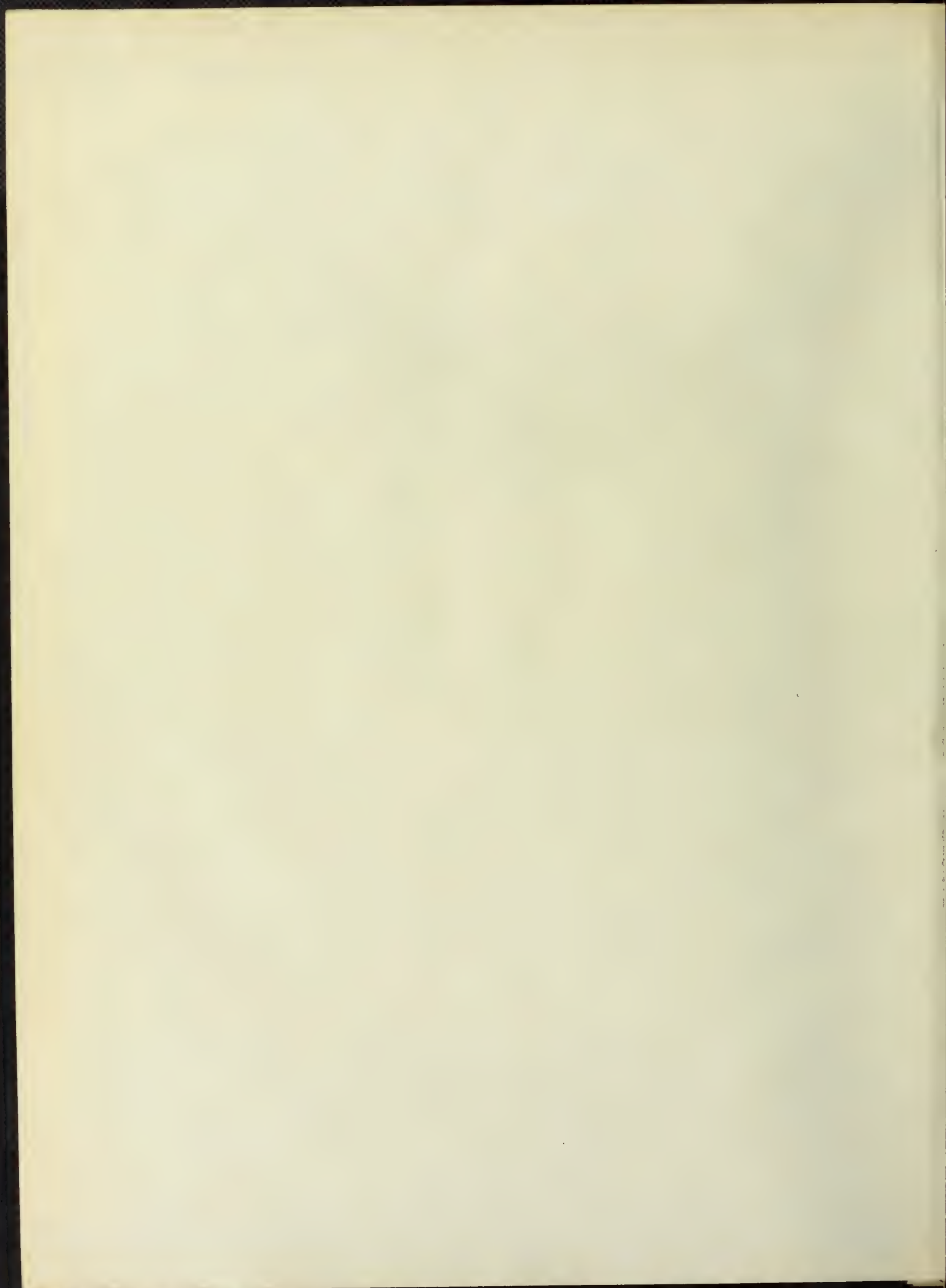
10 Red Cedar posts 10 feet long  
5 White Cedar posts 7 feet long  
2 2x4 pieces 16 feet long  
4 2x4 pieces 12 feet long  
20 ft of 1 1/2" x 2 1/2" x 14 feet  Sent at the mill  
4 pieces of "Rubberoid" roofing  
4 pieces of siding, 6" wide by 14 ft long  
6 pieces 1x4" and 16 feet long.

This bill of lumber comes to \$24.00

#### Class

Old negatives, part 6 1/2 x 8 1/2 inches and part  
4 x 5 inches were utilized at a cost  
of one dollar per thousand. About 2000  
negatives were used in the roof.

They were cleared by incinerating in  
a metal waste tub nearly full of



water to make one part of strong  
 soap suds and a small quantity  
 of soda was added and the mixture  
 was used.

### Boat

A small boat was purchased from the  
 boat shop in Reno. The boat was  
 purchased at a cost of \$4.80 which  
 included its delivery complete with pipe  
 and splices to make it.

### Coal

St. of 500 lbs. of coal was sent to the  
 fire house for use in the boiler for coal  
 burning. \$3.75 per ton for it.

### Feet

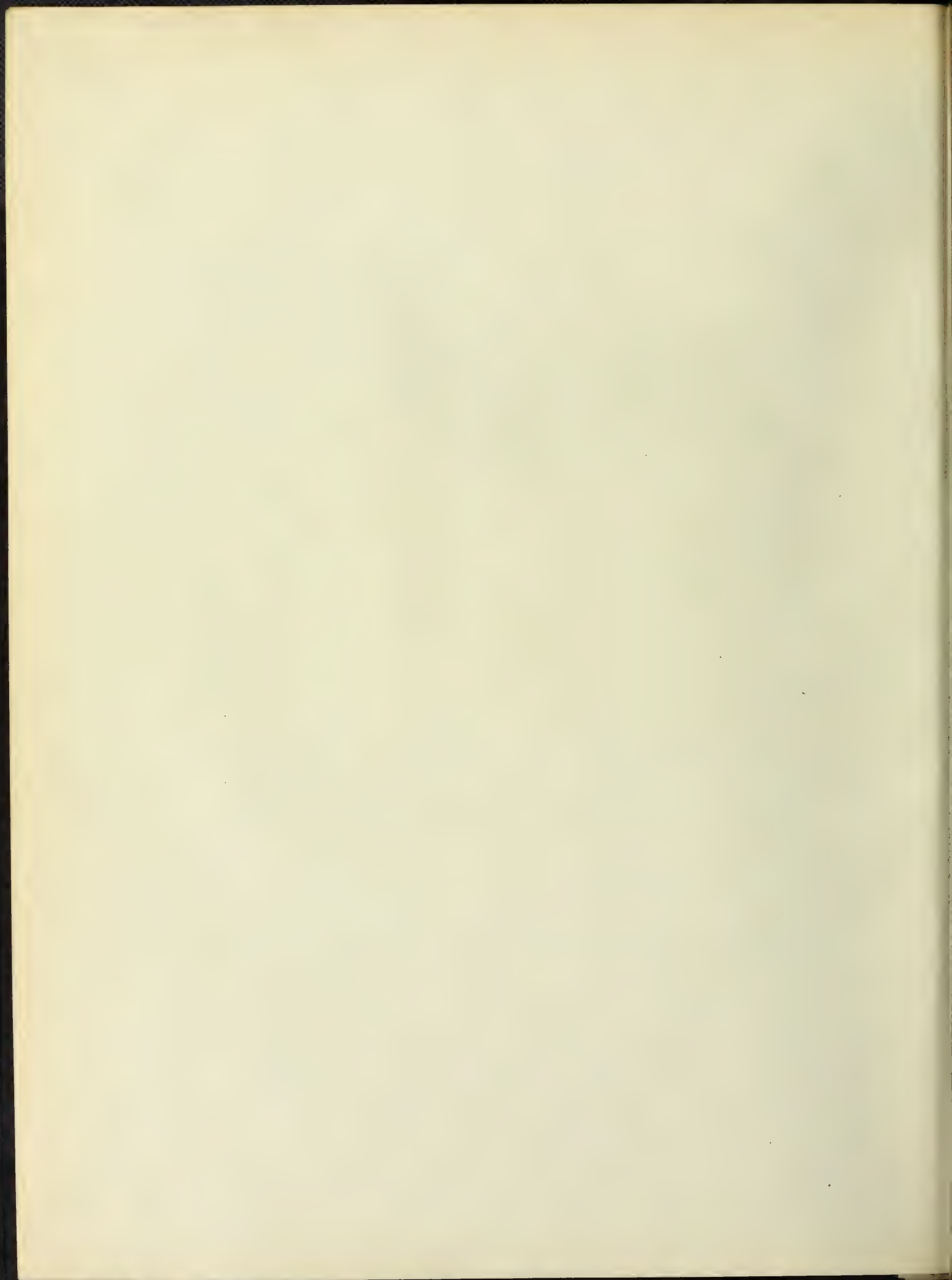
The 25 pounds of putty was necessary  
 and was sent to the pound for its use in  
 sealing the fire.

### Hardware

Nails, hinges and bolts cost 85 cents.

### Siding

Old packing boxes were obtained for the  
 hauling, and ripped apart for siding.



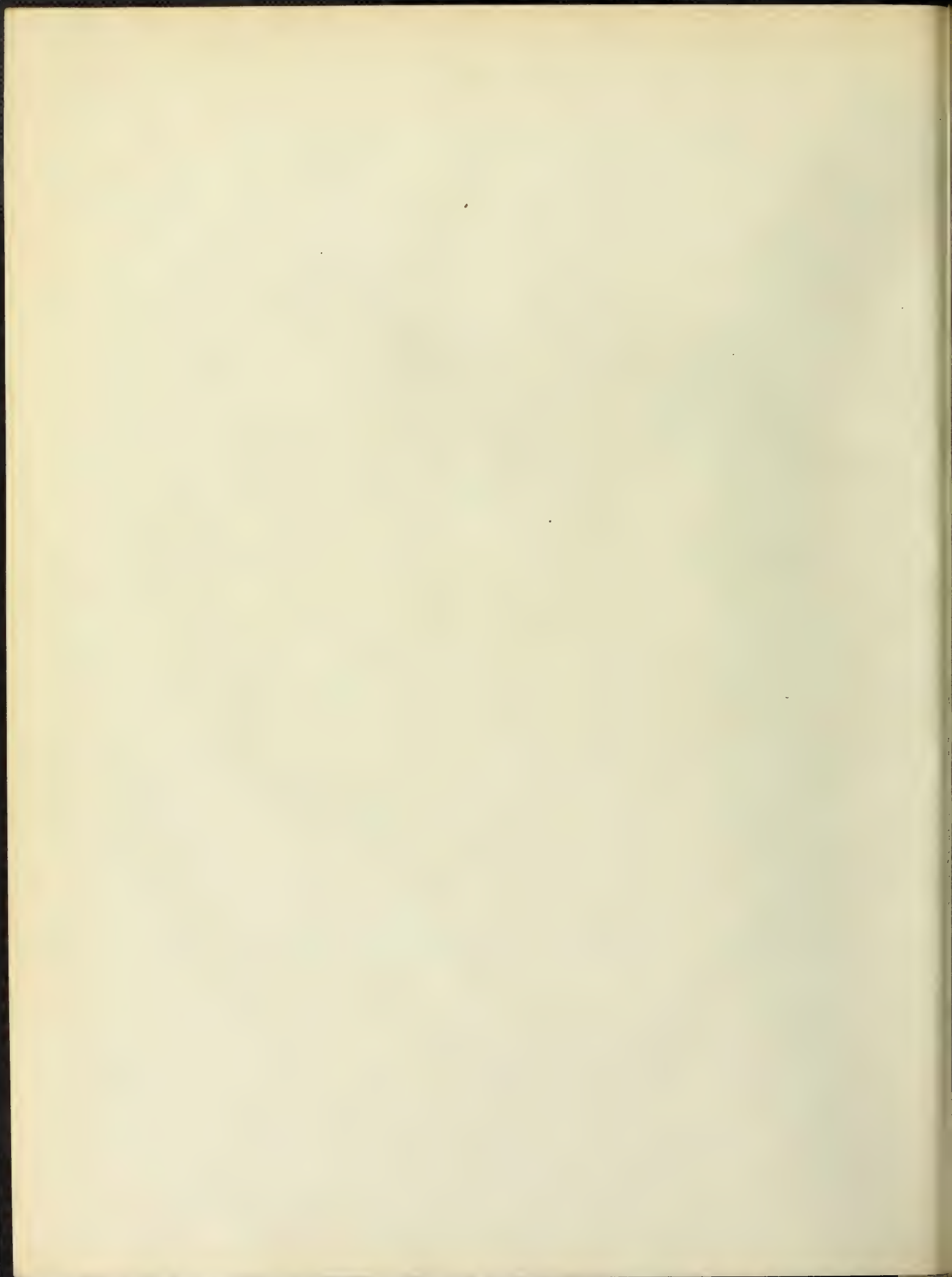
## Benches.

In Figure 1 it will be seen that there are two benches, one 24 inches high, the other 10 inches high. The position of the benches in the house will also be noted. The low bench gives plenty of head room for tall crops such as wheat, oats, and corn which in the greenhouse often attain a height of six feet.

The benches are made of rough lumber, (cypress), are four feet wide and sixteen feet long. They may be made with a wooden rim to hold dirt or with a flat top upon which pots and flats of soil may be set.

The greenhouse bench is built like an ordinary carpenter's table and may be stationary or movable.

The benches used in this experiment were loaned by the Agronomy Department of the College of Agriculture.

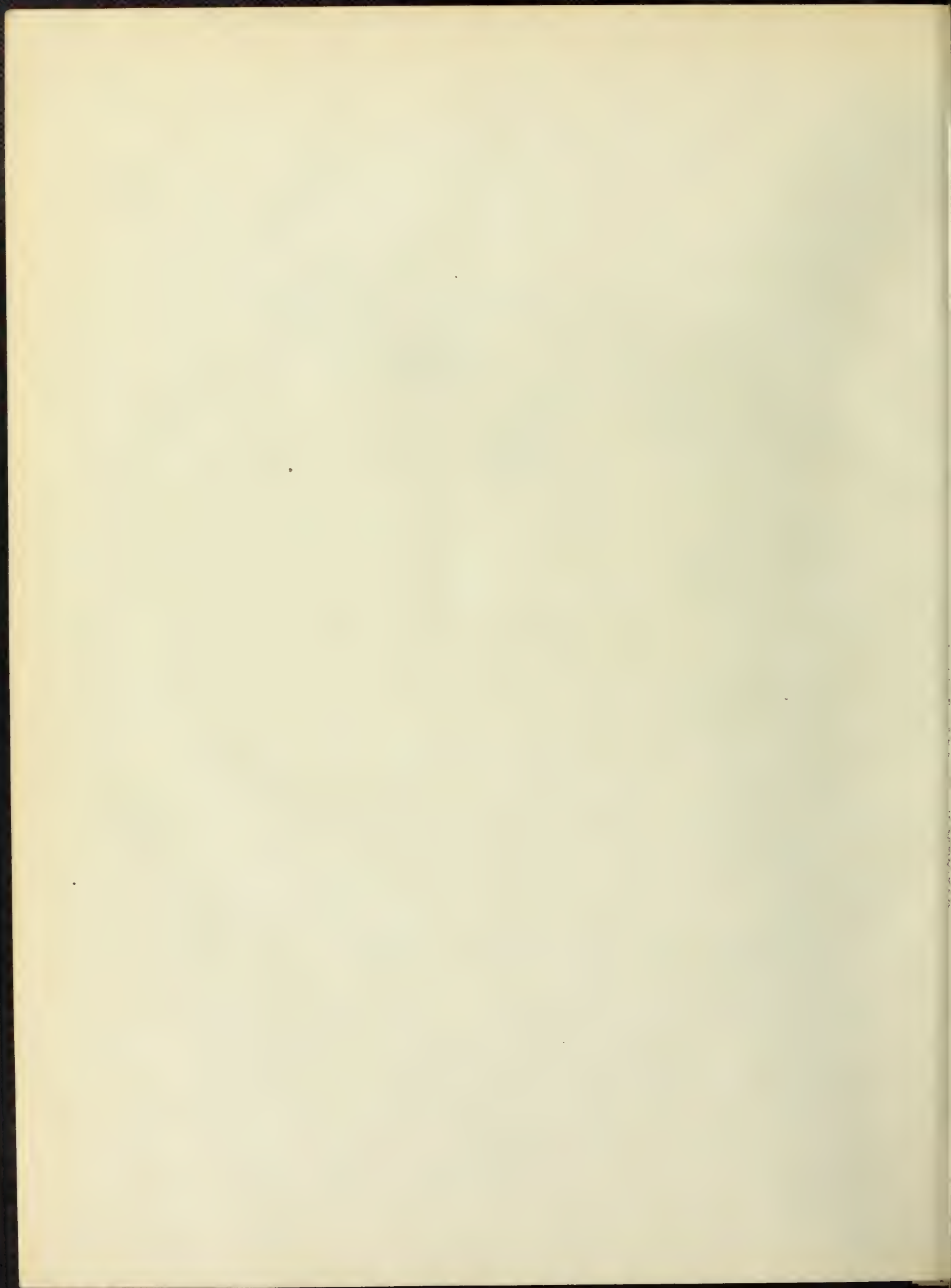


Cost of material and labor.

It should be understood that at this University, one is compelled to purchase a great deal of material which in a high school community ought to come as a donation.

The various items now on which might be able to entirely done away with in high school work, and students in manual training could do most of the work under the direction of the instructor.

Over entire bill for labor was \$13.21.  
 cost of the work cost was 20¢ per hour.  
 The instructor (St. Paul) put up  
 the furnace and built the building of  
 the house 15¢ per hour.

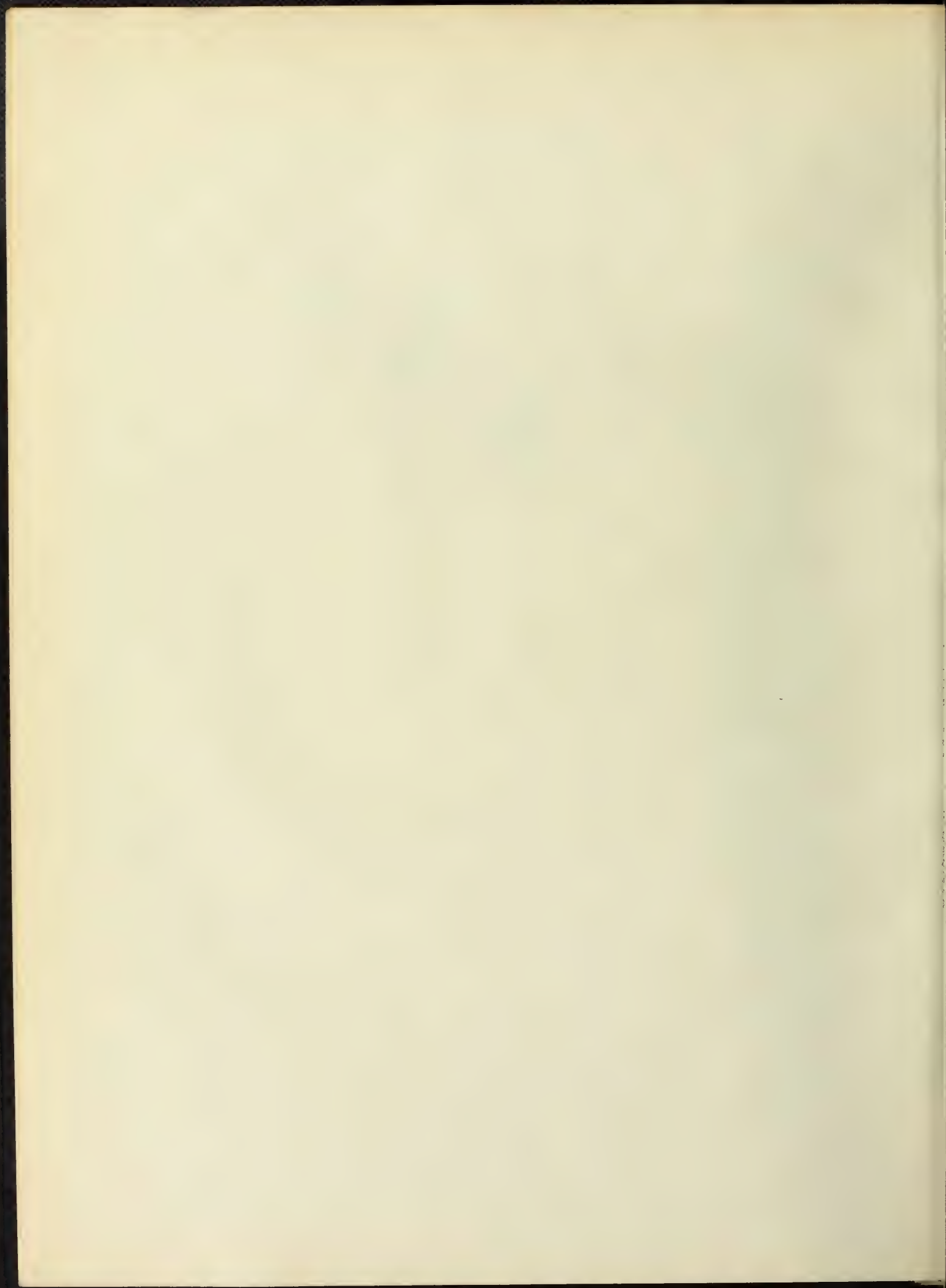


## Heating

It is not a bad idea to get a  
small supply of sufficient fuel to get  
during the weather in a few days  
(I don't know) but the coal stores  
at night. Large amounts of fuel  
should be kept for a few days at night and  
with a little extra coal in the furnace  
may be kept at 50 degrees at all times.

The same business being hard and is  
better, though more expensive.

It is a good idea to get a steam  
boiler water from the furnace including  
a little of the difficulty and it  
can be done.

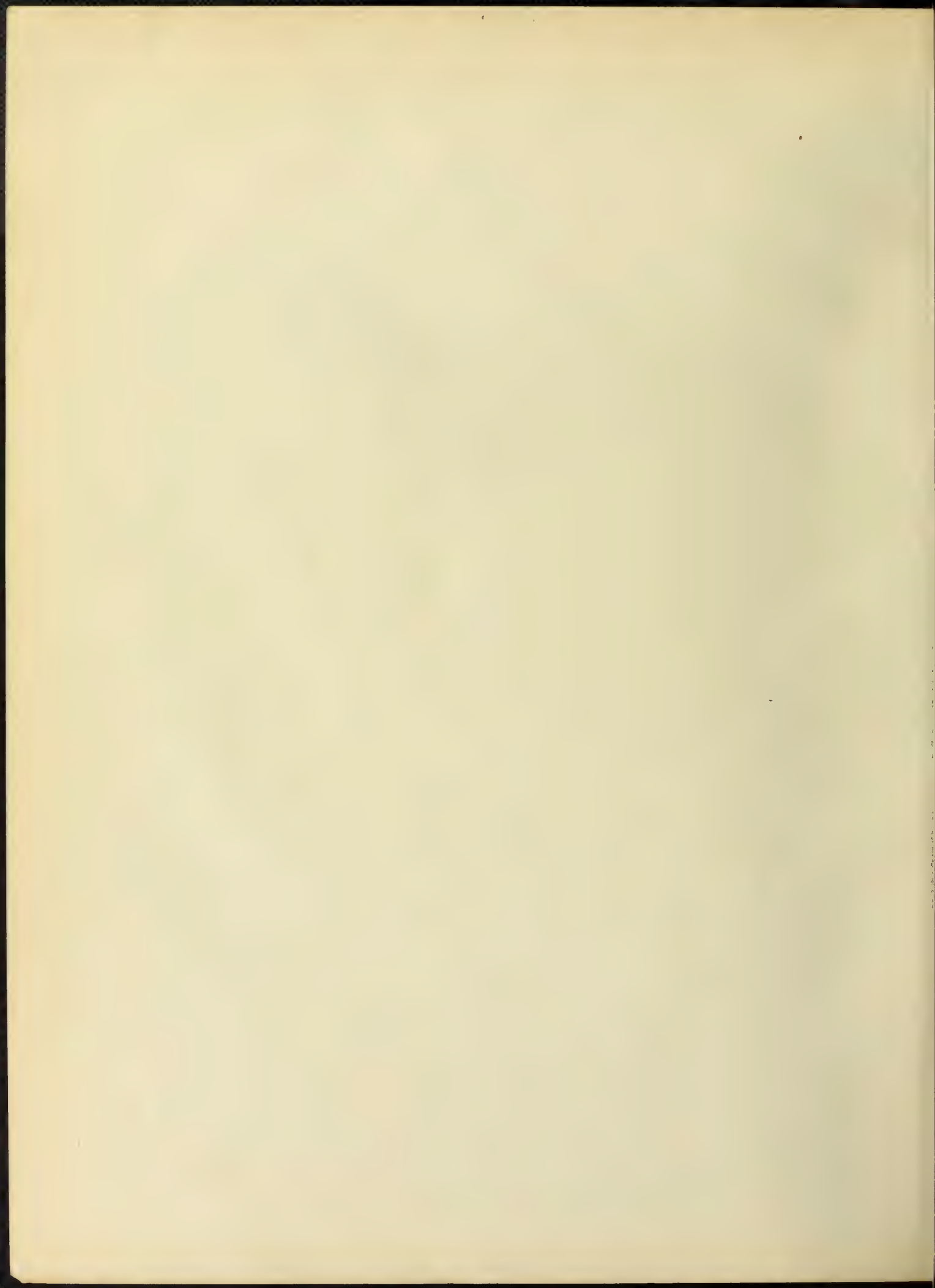


Glazing the greenhouse.

When the glass is ready, it must be laid very carefully in your mould, one raised. Beginning at the bottom of the row, each piece is secured by small bricks or glazing points. The next piece laps about  $\frac{1}{2}$  inch for the next. Between rafters allow about  $\frac{1}{2}$  inch "play" for irregularities in the glass.

After the glass has been put down it must be putted, and here a know in the skillful use of putty is at hand.

I consider glazing the most difficult task in the construction of the greenhouse. It must of course be done in dry weather, and for this reason alone, I urge upon teachers to begin the construction of the greenhouse with the beginning of the fall term.



## Horticulture.

Our elementary texts in agriculture and horticulture are found in the suggestions as to what may be accomplished in cultivating the green houses. *Recreation*, p. 121. (Principles of Gardening, Part 1, 4th ed. Book, Principles of Fruit Growing, Horticulture, 1st Book, 1st ed. Principles of Plant Culture, and Illinois Bulletin 144).

Vegetable seeds were planted in shallow boxes (spots) for "flats" early in the season. The seeds were planted in the boxes and the plants were planted in the flats. When the plants grew they were shifted to large boxes in the flat and to flats (see notes, p. 121).

The plants from the flats (see fig. 6) gave entire satisfaction.

Later in the season (April and May), some of the plants were shifted to the other cold frames (see fig. 5).

Several dozen plants to one or two plants were sold, and many more might have been sold, if we had had room to

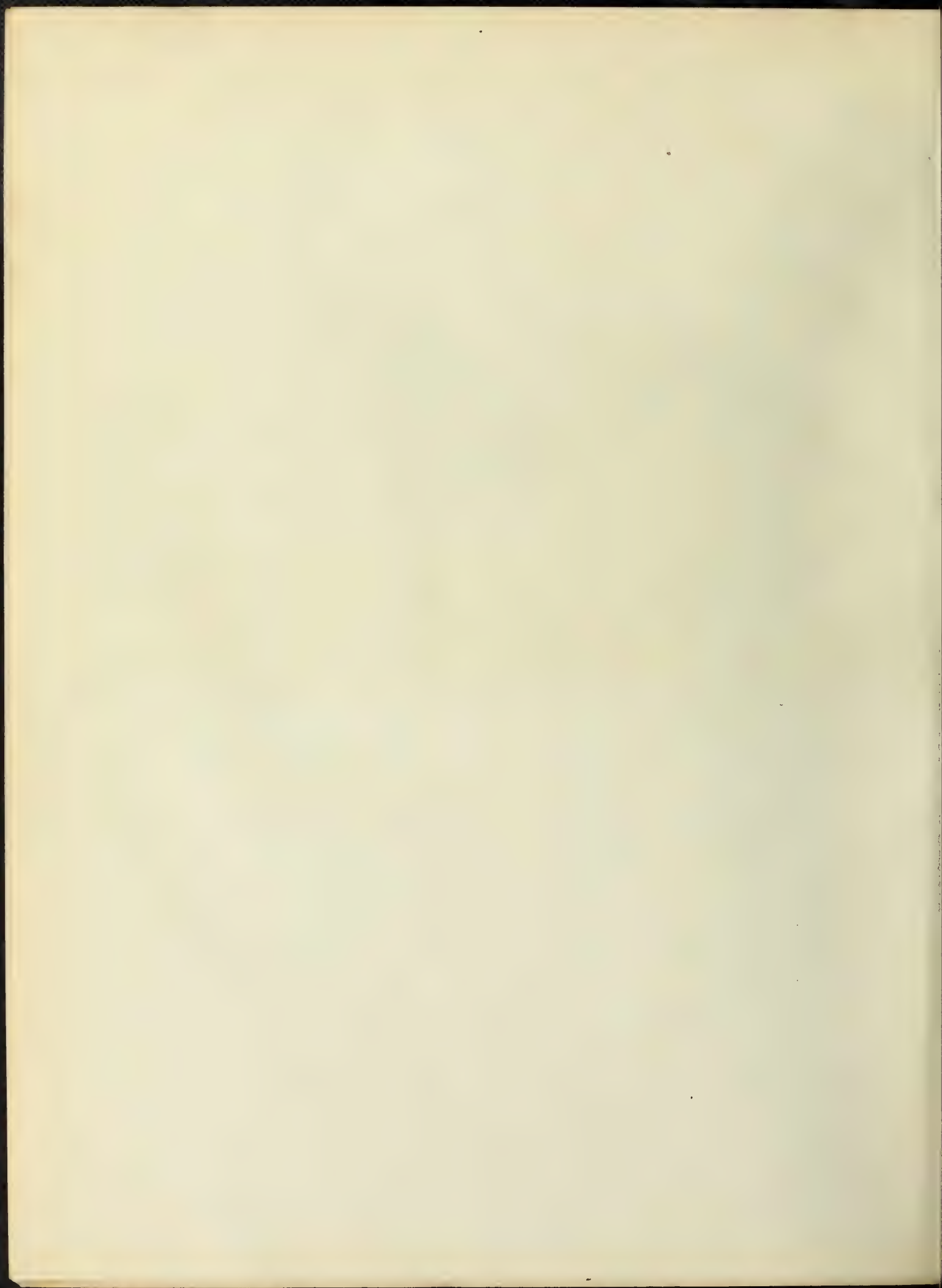
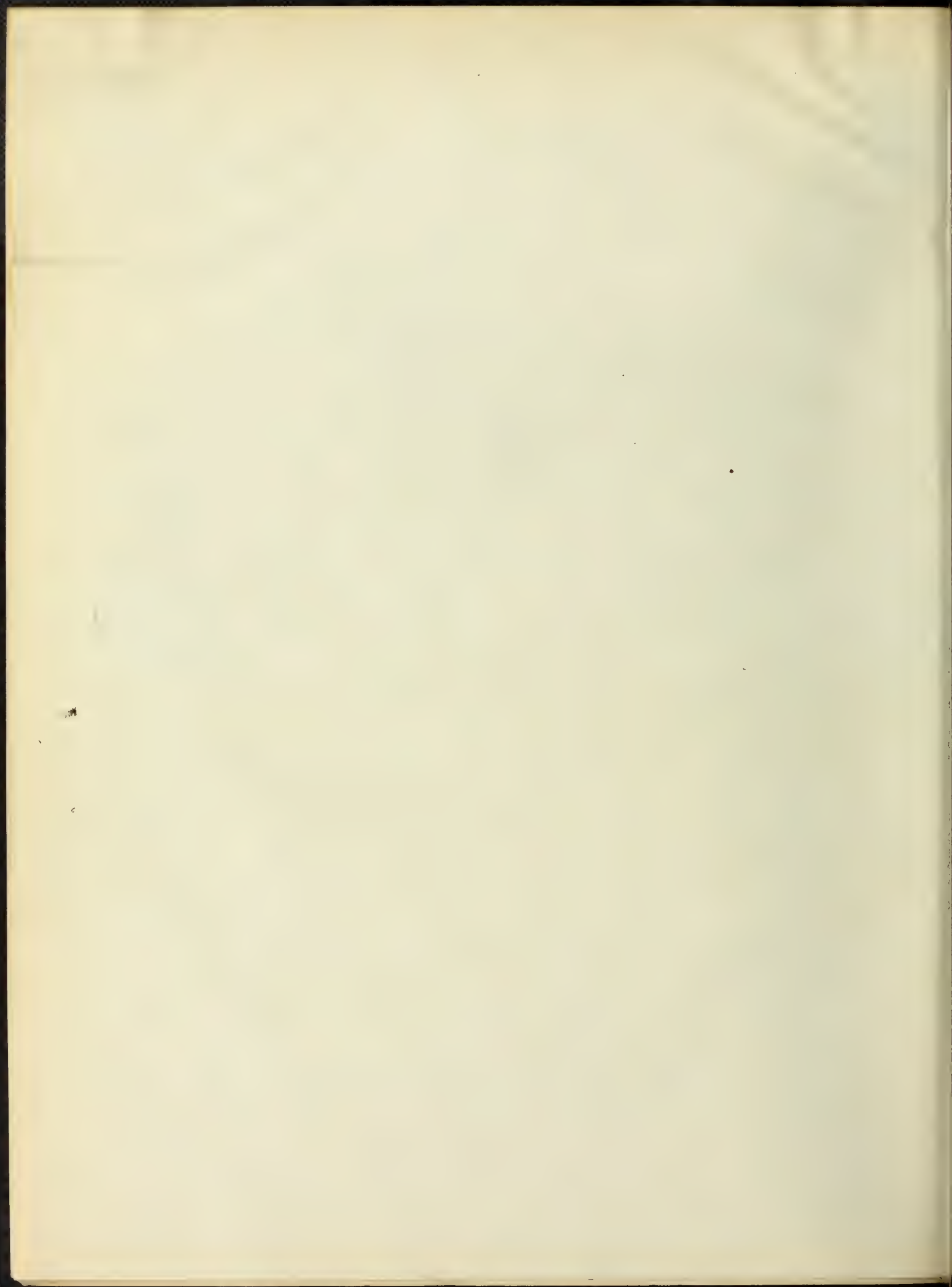




Fig. 6

Tomato plants grown in paper pots. The large pot the seeds were sown in. Started February 12th, and this is the first to set fruit. The plant in the set fruit box May 1st.

In the smaller pots the plants were transplanted from the seed box. These paper pots which cost but \$3.85 per 1000, served very nicely for growing plants for sale or for shipping.

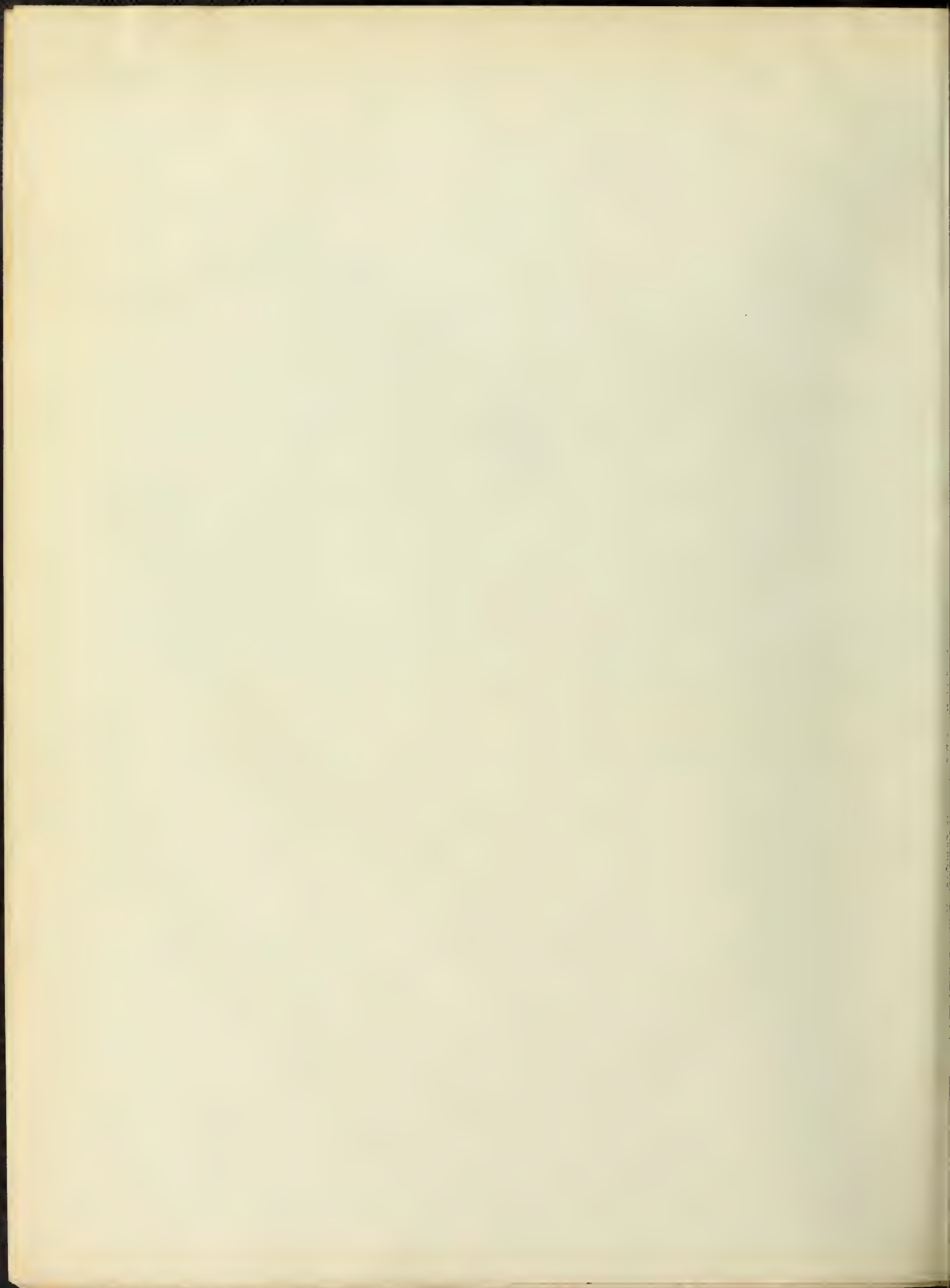


rain H.

H. 2

The seed propagating method is used in a field and cover of ground and culture. The seed is sown in the Academy student. The cuttings are rooted in a potted soil. Botanical seed is a seed which might have easily been grown from stems and sprouts from the seed.

As a class exercise, seed catalogs may be thoroughly studied, and a few selections made from standard and new promising varieties. This is for describing the seed, and a description of the seed plants of new kinds and seed. The growth in a structure of the seed.



## Soil Water - Unit of Soil

Vol 8, p. 100

It is found that soil water, from  
gallons of water in a soil with a 1% water  
content in the hollows of a drainage, some of the  
"surface" water and some in the soil.

It is found that 10 ft. high and 10  
inches across the top diameter. The amount  
of water per foot in square feet to be  
found to the square inch is 160 ft. to  
the acre.

It is found that the soil water is not  
they are interested. The amount of surface  
soil water is found to be 10 ft. of soil of soil  
water. The 10 ft. of soil should  
be represented of the soil water. The  
10 ft. of soil water is found to be 10 ft.  
of soil water. The 10 ft. of soil water  
should be found to be 10 ft. of soil water.  
The 10 ft. of soil water is found to be 10 ft.  
of soil water. The 10 ft. of soil water  
should be found to be 10 ft. of soil water.

The piece of glass gauge used is  
a piece of glass 10 ft. in length and  
10 ft. in diameter. It is placed in  
the soil to find the  
soil water content.

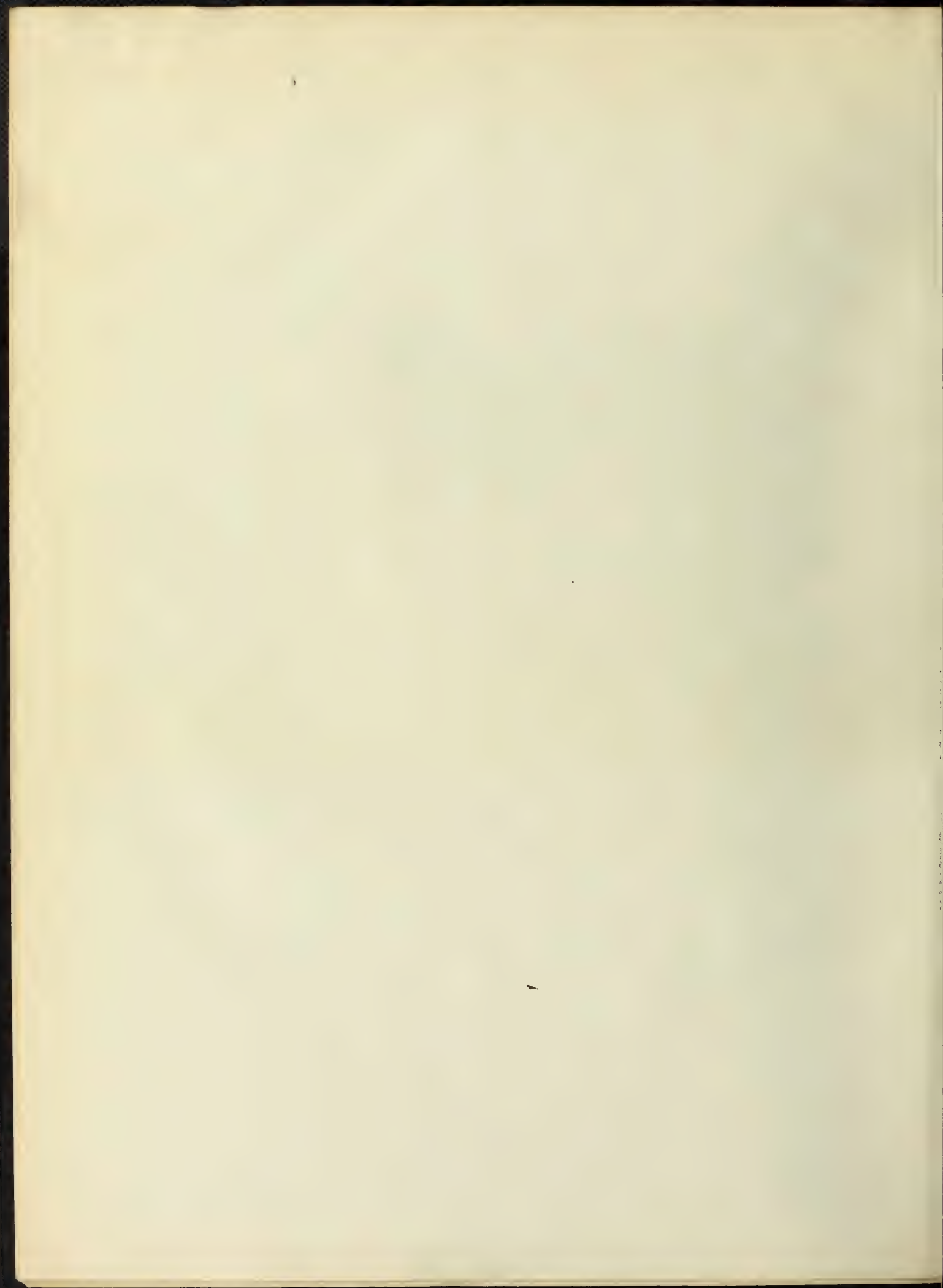
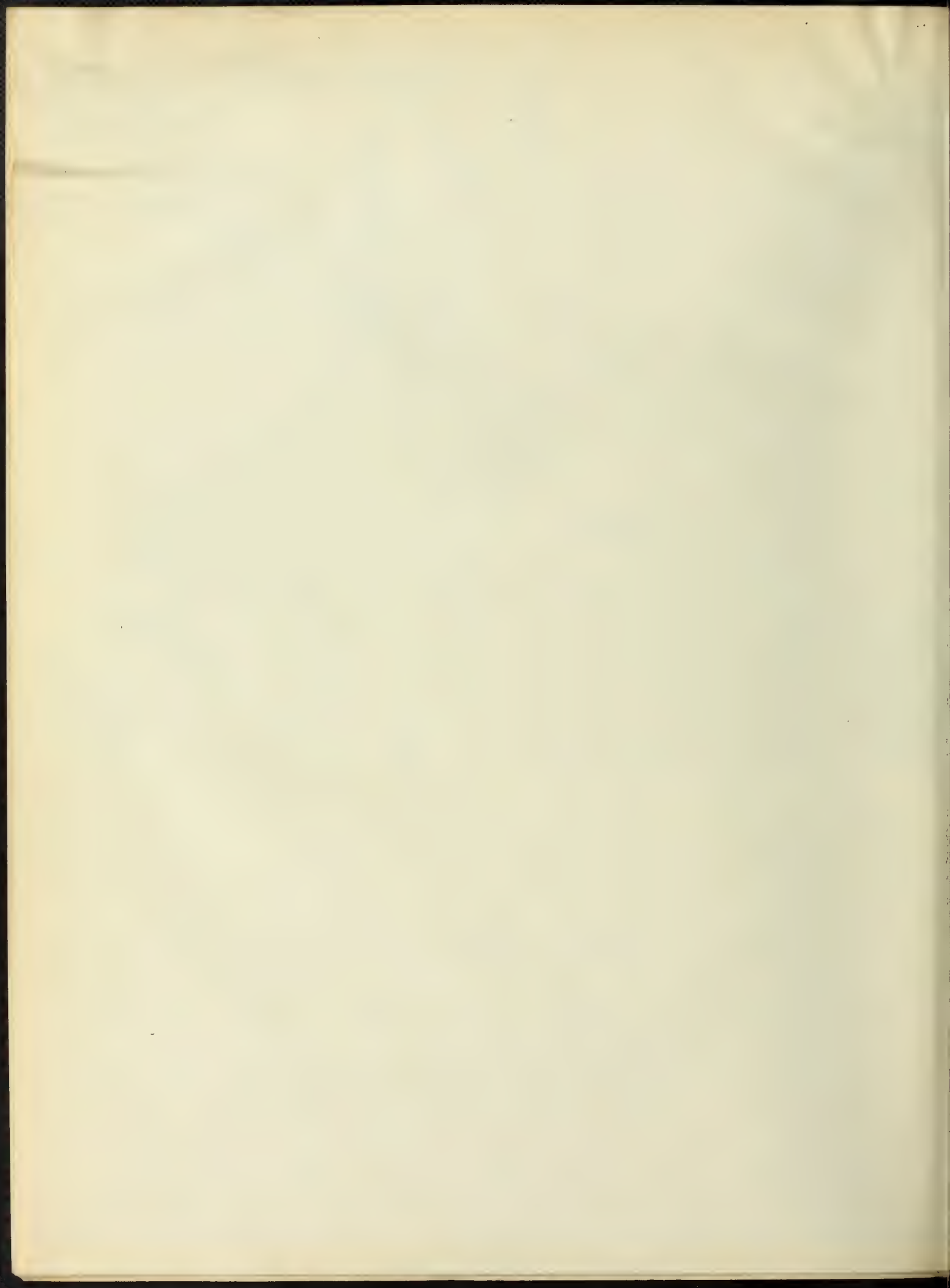


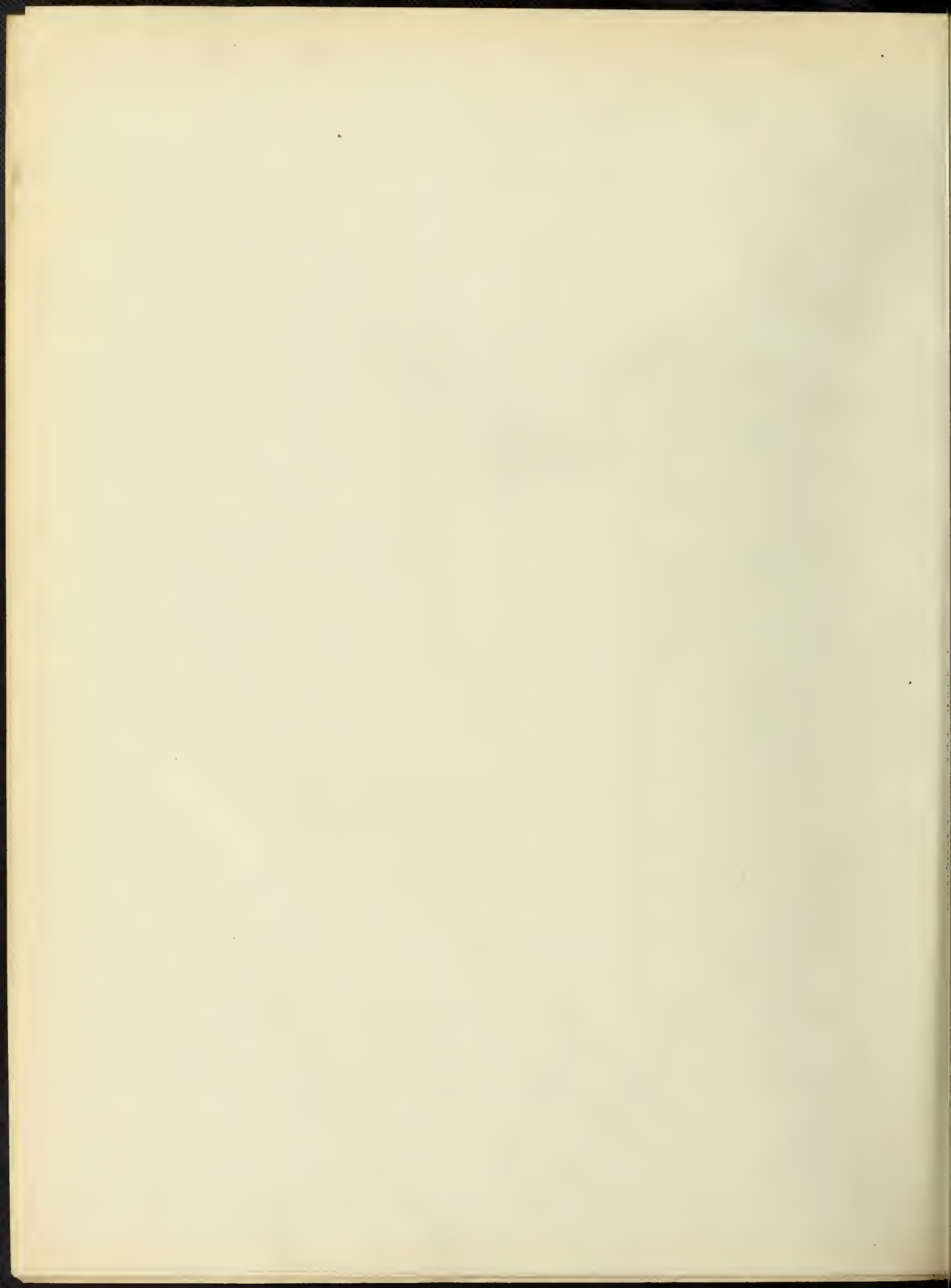


Fig. 3.

The 4-gallon jars used in pot culture work are filled with commercial fertilizers and measures of various kinds are applied to the soil at a definite rate per acre, and striking differences result. It is one very accurate method of determining the needs and deficiencies of a given soil.







Notes in 1880

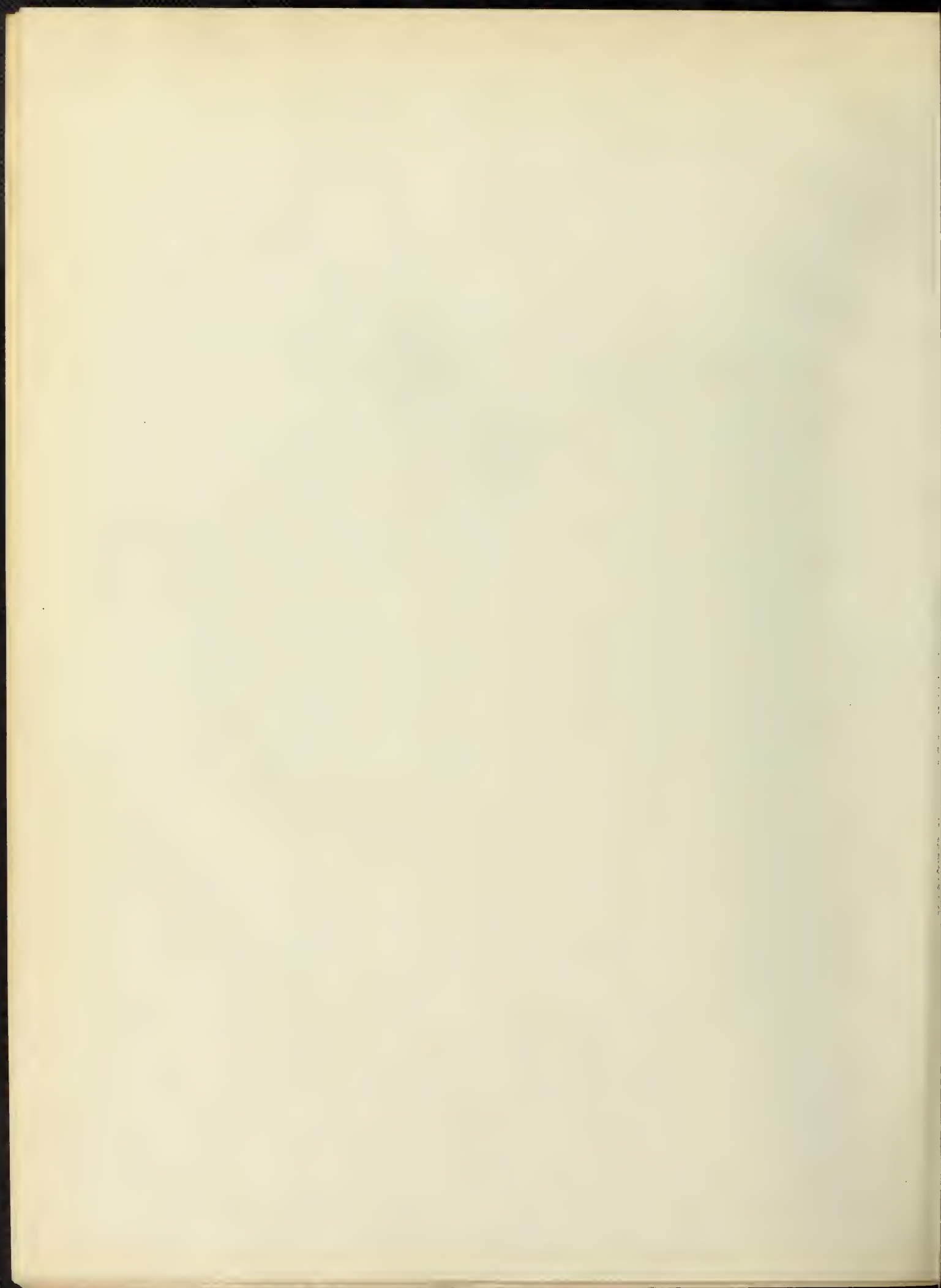
Let me suggest a raising 42 1/2 percent of the land possession. The new ground per acre is equivalent to 480 pounds per acre.

Let me

Let me suggest a raising 42 1/2 percent of the land possession. The new ground per acre is equivalent to 480 pounds per acre.

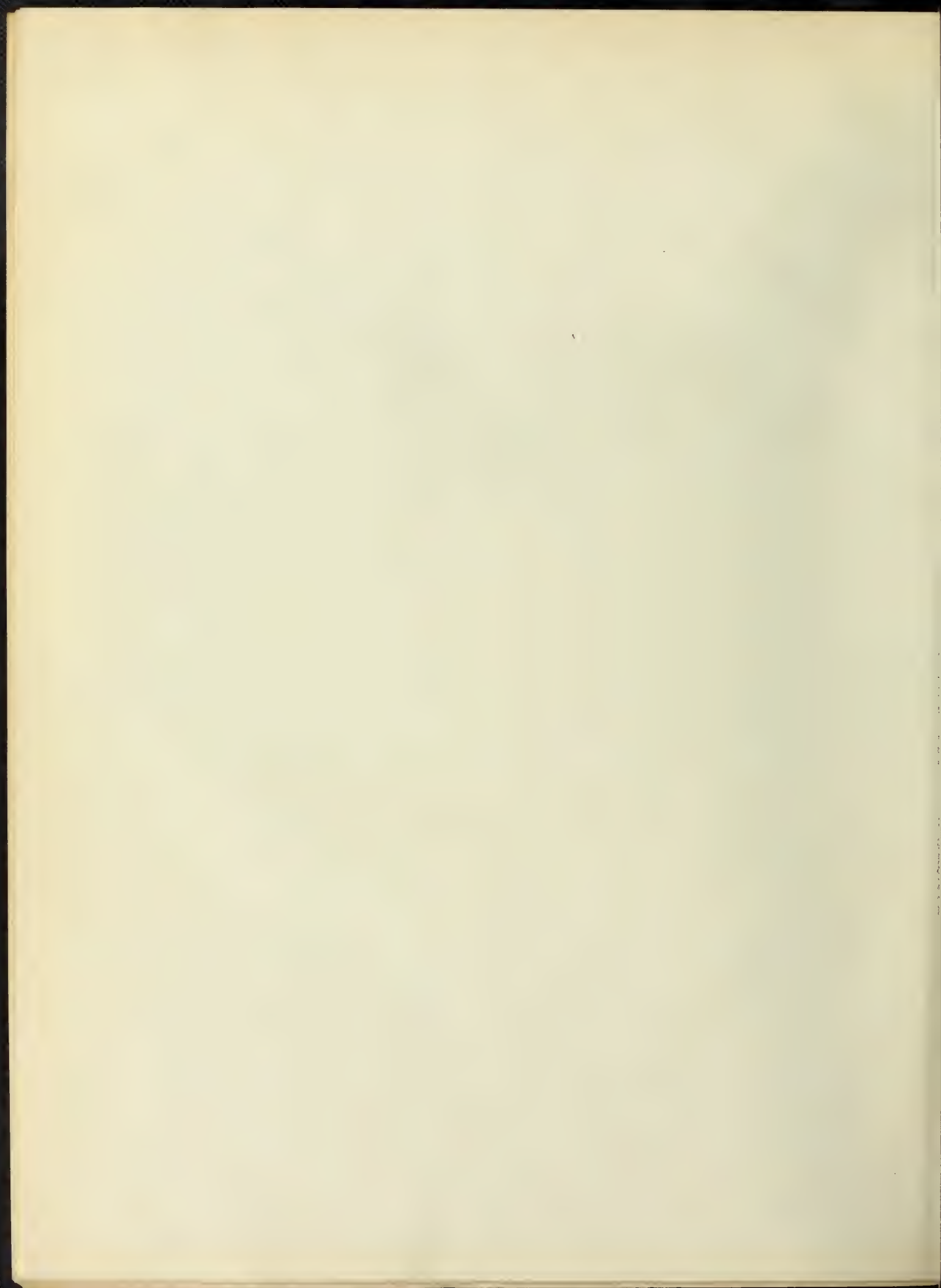
Let me suggest a raising 42 1/2 percent of the land possession. The new ground per acre is equivalent to 480 pounds per acre.

Let me suggest a raising 42 1/2 percent of the land possession. The new ground per acre is equivalent to 480 pounds per acre.



Plat. 9.

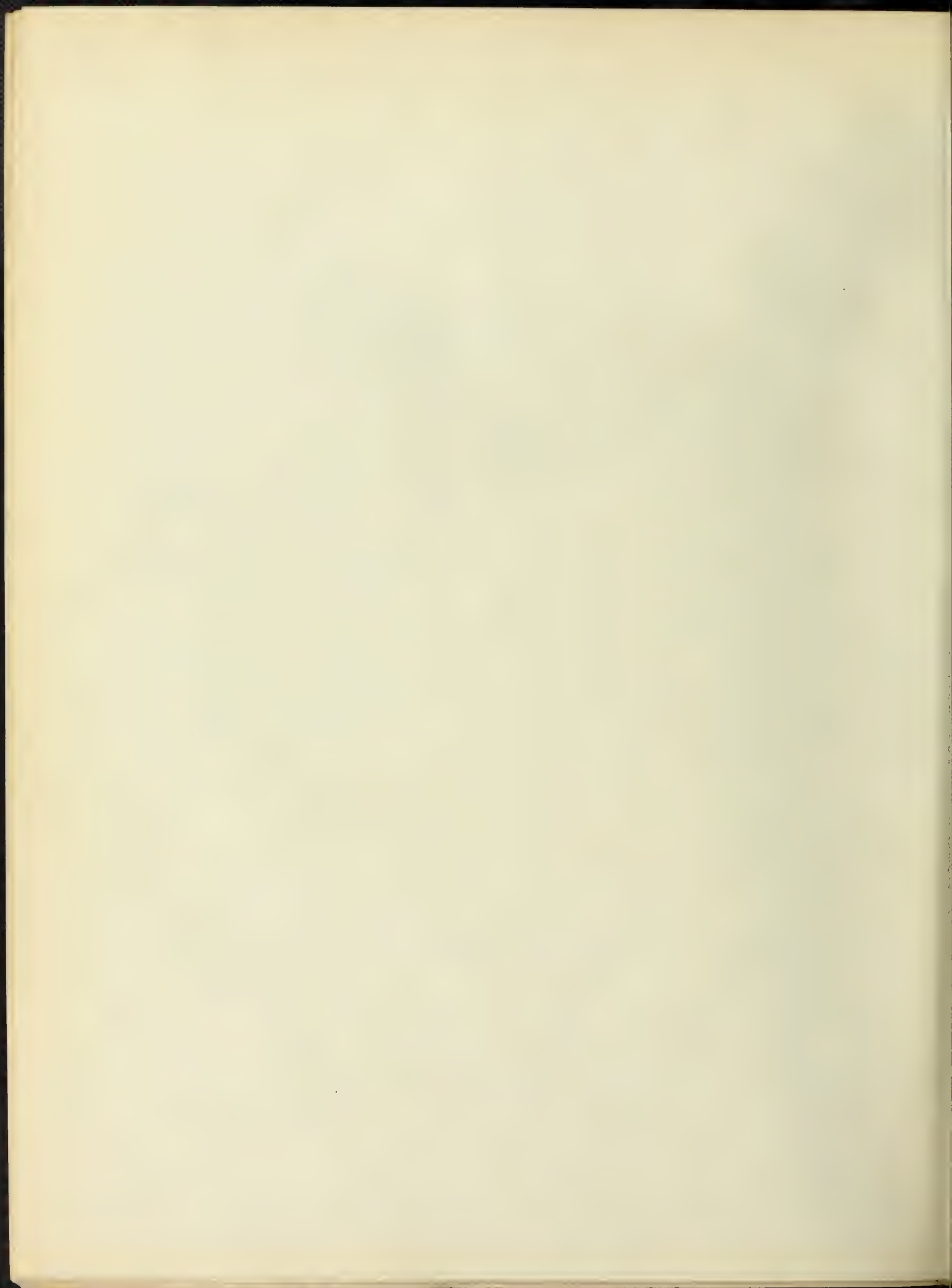
the original of



The simple point, that  
 the paper is not intended  
 and the date is state not so  
 date is usually at hand

After the work is fully finished, it is  
 it is established (not above the threshold of the masses).  
 But it is not in the paper,  
 mounted carefully according to the part of the  
 and kept in a dry, warm place until fully  
 dry. If the stock is in June the company  
 be the first kept in the set of  
 in September, when it is not done  
 and the records taken.

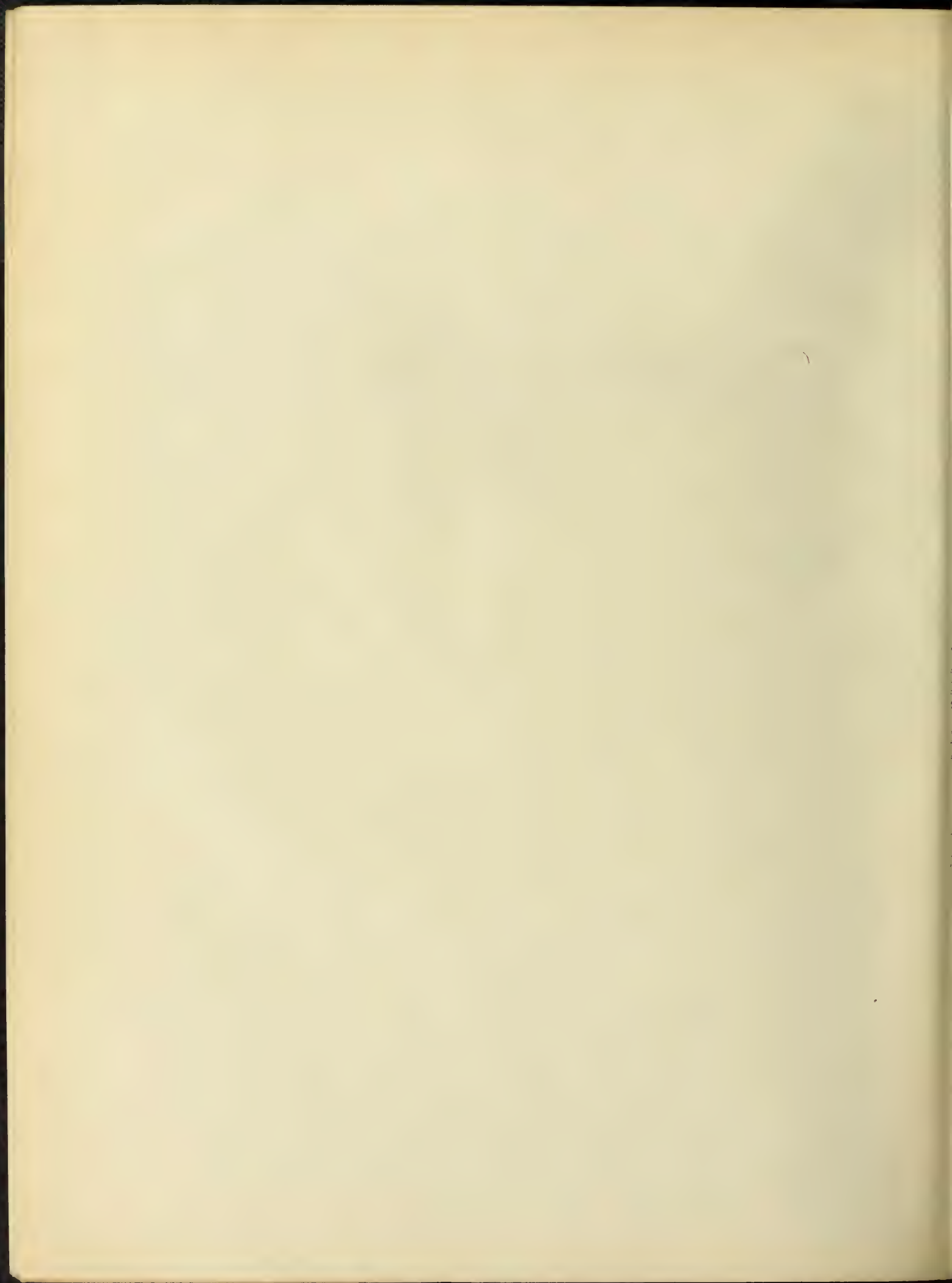
Just after the paper is  
 weighed, the stock and cards are  
 each stock measured for the tip of the card,  
 and a large date is written on the  
 next to the one. But the gain is there  
 checked by pulling between the fingers  
 into a small loop, and carefully blowing  
 away the chaff.



Pot Culture Work - Cultures grown in  
High School Greenhouse. (1910).

Wheat - Simple Fertility Test.

| No. | Treatment   | Weight<br>of Grain | Weight<br>of Straw | Wt. Sep | Number of<br>Heads | Number<br>of Stems | Average<br>Length<br>of Stems |
|-----|-------------|--------------------|--------------------|---------|--------------------|--------------------|-------------------------------|
| 1   | None        |                    |                    |         |                    |                    |                               |
| 2   | Nitrogen    |                    |                    |         |                    |                    |                               |
| 3   | Phosphorus  |                    |                    |         |                    |                    |                               |
| 4   | Potassium   |                    |                    |         |                    |                    |                               |
| 5   | N.P         |                    |                    |         |                    |                    |                               |
| 6   | N.K         |                    |                    |         |                    |                    |                               |
| 7   | P.K         |                    |                    |         |                    |                    |                               |
| 8   | N.P.K       |                    |                    |         |                    |                    |                               |
| 9   | Lime, N.P.K |                    |                    |         |                    |                    |                               |
| 10  | Lime.       |                    |                    |         |                    |                    |                               |



Large and Small Her. in Test.

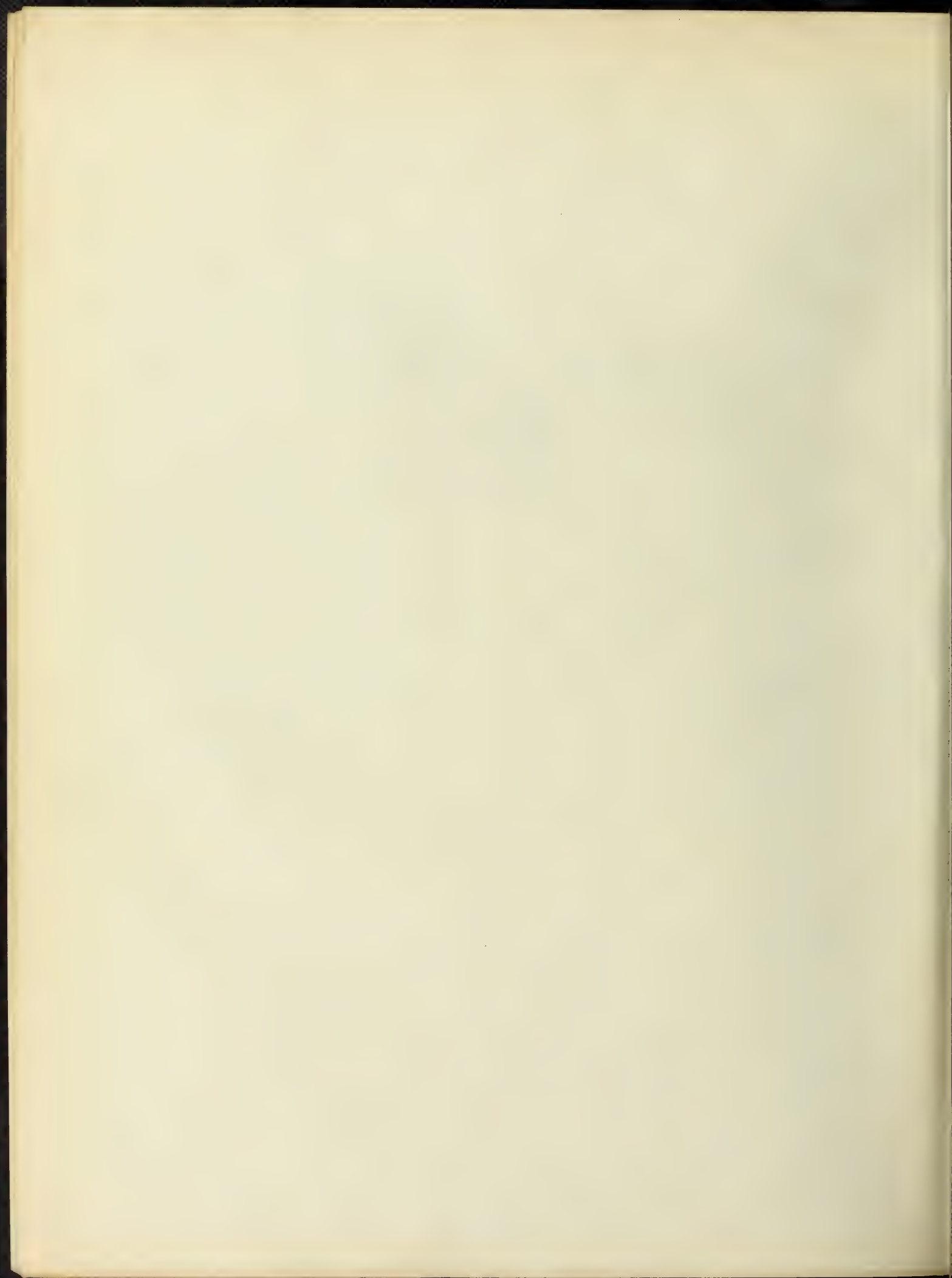
Large and small  
herms of heat are carefully selected  
and planted in different pots. In the  
pots "A" and "B" In A plant the largest,  
plumpest herms obtainable. In B plant  
only the smallest, most stunted herms.  
Take careful notes as to rate of germination,  
rate of growth and final yield of crops.  
The soil must be sand or loam  
mixed before putting it in the pot.

There is no M. in.

This part of manure (urine 40%, dung  
60%, straw 10% - by weight) with the first  
five inches of soil at the rate of 20  
tons to the acre (1 grain to the pot equals  
160 pounds to the acre).

The duplicate pot contains the same  
kind of soil, but has no manure.

Try wheat or oats, or any of possibilities  
in this test.



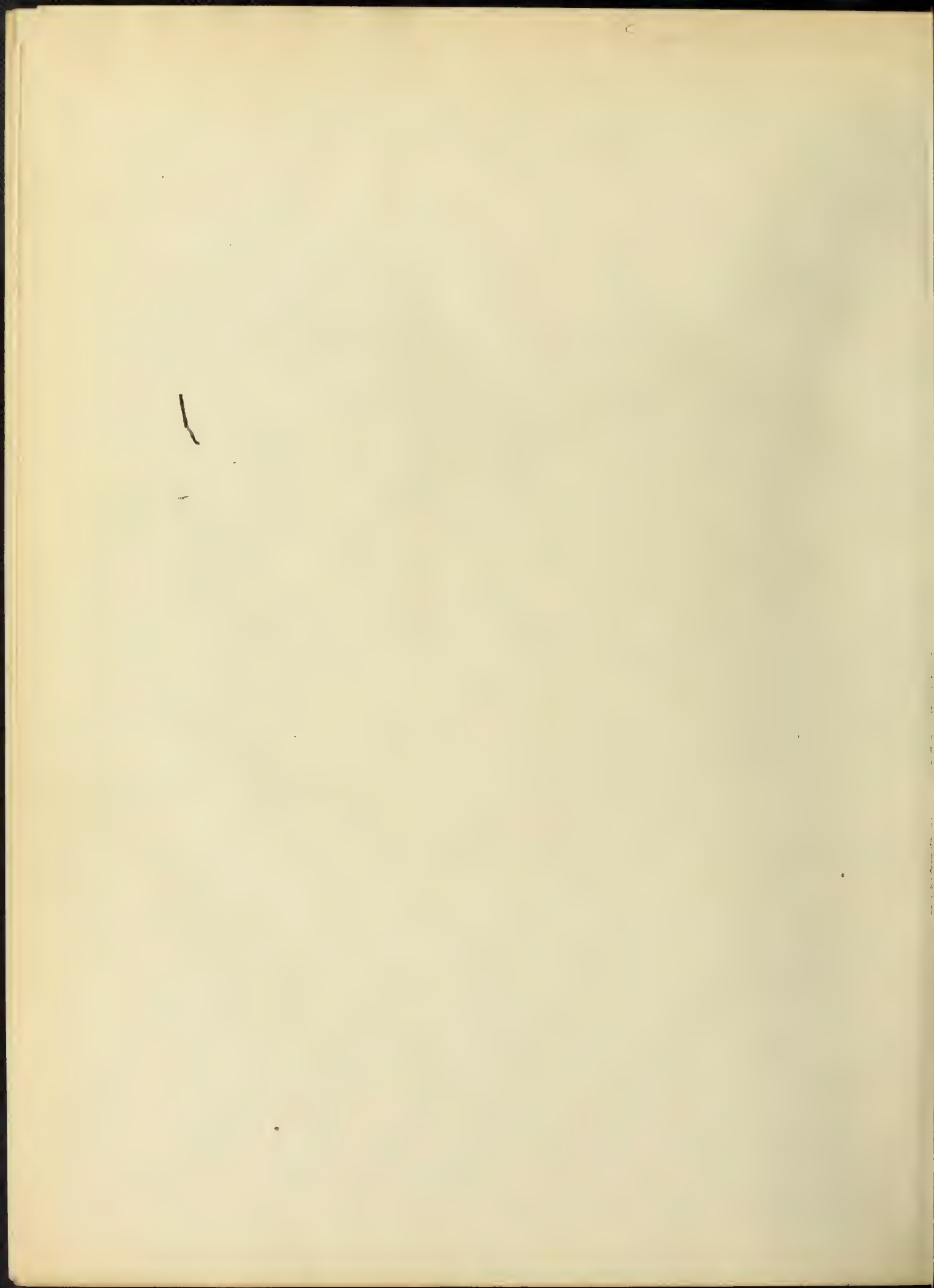
## Sand Cultures.

Directions for the preparation of cultures in pure sterile sand are given below. These directions are taken from the Laboratory Manual for Soil Fertility by C. G. Hopkins and J. H. Pettit.

They furnish valuable demonstrations as to the value of each element of plant food, and the effect upon the plant of the absence of a single essential element.

Directions for the preparation of plant food solutions are also given.

From the work of the class in Soil Fertility several photographs have been selected. This work may very well be done in secondary schools and the results are an invaluable lesson and supplement beautifully text book work on fertilizers.



#### PREPARATION OF POT CULTURES.

Use clean, white sifted sand in 5-liter heavy glass battery jars, having a 1 cm. hole within 1 cm. of the bottom. Into the hole fit a drain tube made of glass-tubing with a glass-wool filter at the inner end, so that it will take liquid from the lowest place in the jar. Put up a series of ten of these pots, eight to be used as indicated in the table below and two in an experiment to be devised by the student. The previous treatment of the sand in the latter two will depend upon the experiment to be made.

To extract the sand, fill the jar within 1 cm. of the top with dry sifted sand and add to this dilute sulfuric acid (made by adding 100 cc. of concentrated chemically pure sulfuric acid to 900 cc. of ammonia-free water) until the sand is saturated. Let stand two hours and then add ammonia-free water, allowing the drainage to flow into a second jar until it is saturated. Allow this jar to stand two hours and then wash both with ammonia-free water until free of acid. In this way any soluble plant food is removed from the sand and one portion of acid extracts two jars. The sand for two of the jars, in which experiments are to be made to show the effect of nitrogen-gathering bacteria, is first heated to 120° to 130° for one-half hour and then extracted and washed as above.

Before planting, mix with the sand of each pot 10 gm. of pure calcium carbonate.

In making applications of plant food as indicated in the following table and in such amounts as are shown in Practice 16 the solutions to be applied to each pot are to be mixed together, and diluted to 1000 cc. Mix thoroughly and apply the whole amount to the pot, allowing any water present to be forced out through the drain.

The first application of the plant food solutions is to be made at the time of planting, the second three weeks later, the third two weeks later, and subsequent applications at intervals of one week, each time making the application as directed above.

Each student in each group will prepare and care for a series of pots as indicated in the following table.

#### PREPARATION OF PLANT FOOD SOLUTIONS.\*

Solution No. 1.—Nitrogen: Dissolve 80 gm. of ammonium nitrate in 2500 cc. of distilled water. Use 10 cc. per pot.

Solution No. 2.—Phosphorus: Dissolve 25 gm. of monocalcium phosphate in 2500 cc. of ammonia-free water. Use 10 cc. per pot.

Solution No. 3.—Potassium: Dissolve 50 gm. of potassium sulfate in 2500 cc. of ammonia-free water. Use 10 cc. per pot.

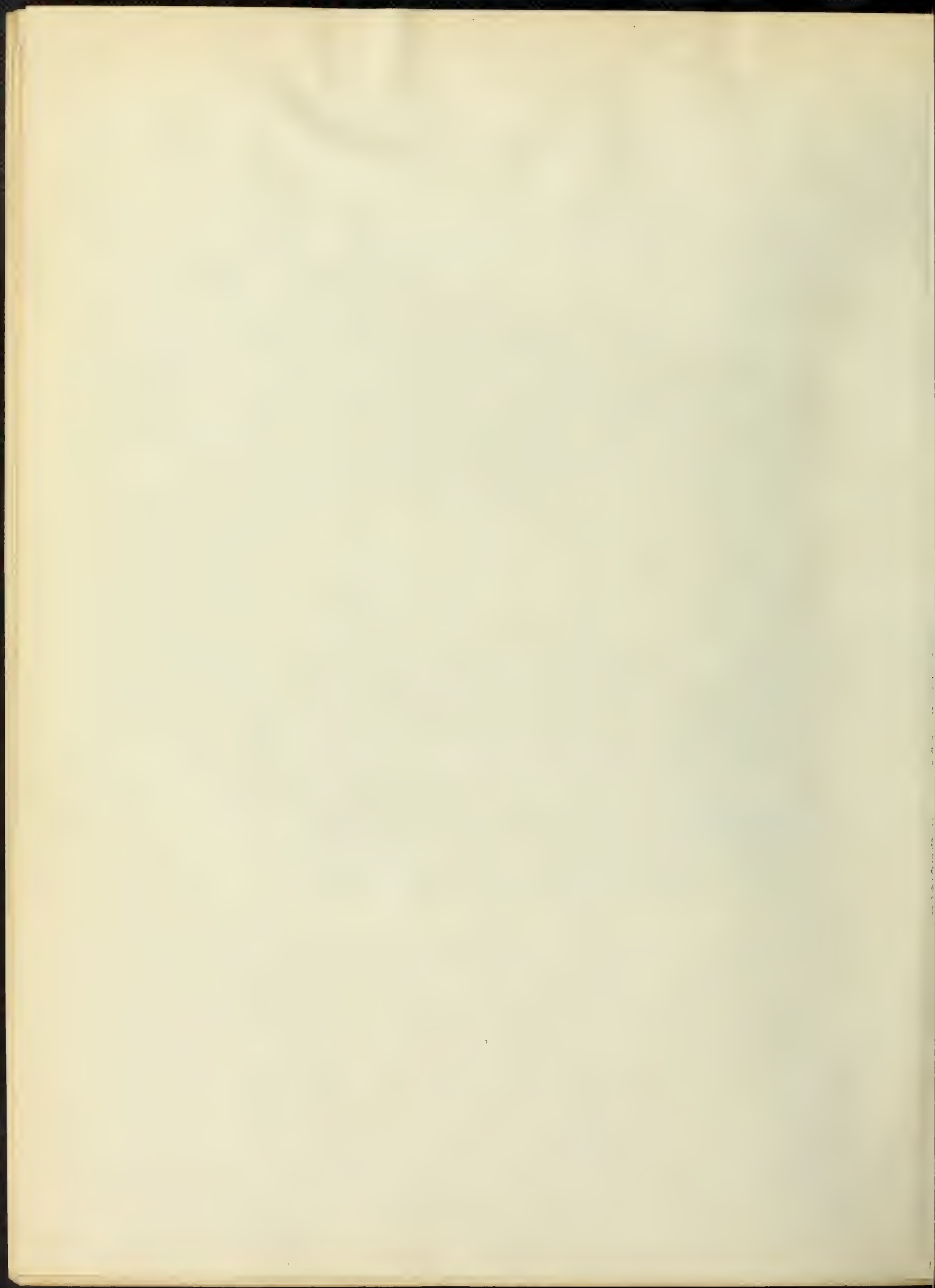
Solution No. 4.—Magnesium: Dissolve 20 gm. of magnesium sulfate in 2500 cc. of ammonia-free water. Use 10 cc. per pot.

Solution No. 5.—Iron: Dissolve 0.1 gm. ferric chlorid in 250 cc. of ammonia-free water. Use 1 cc. per pot.

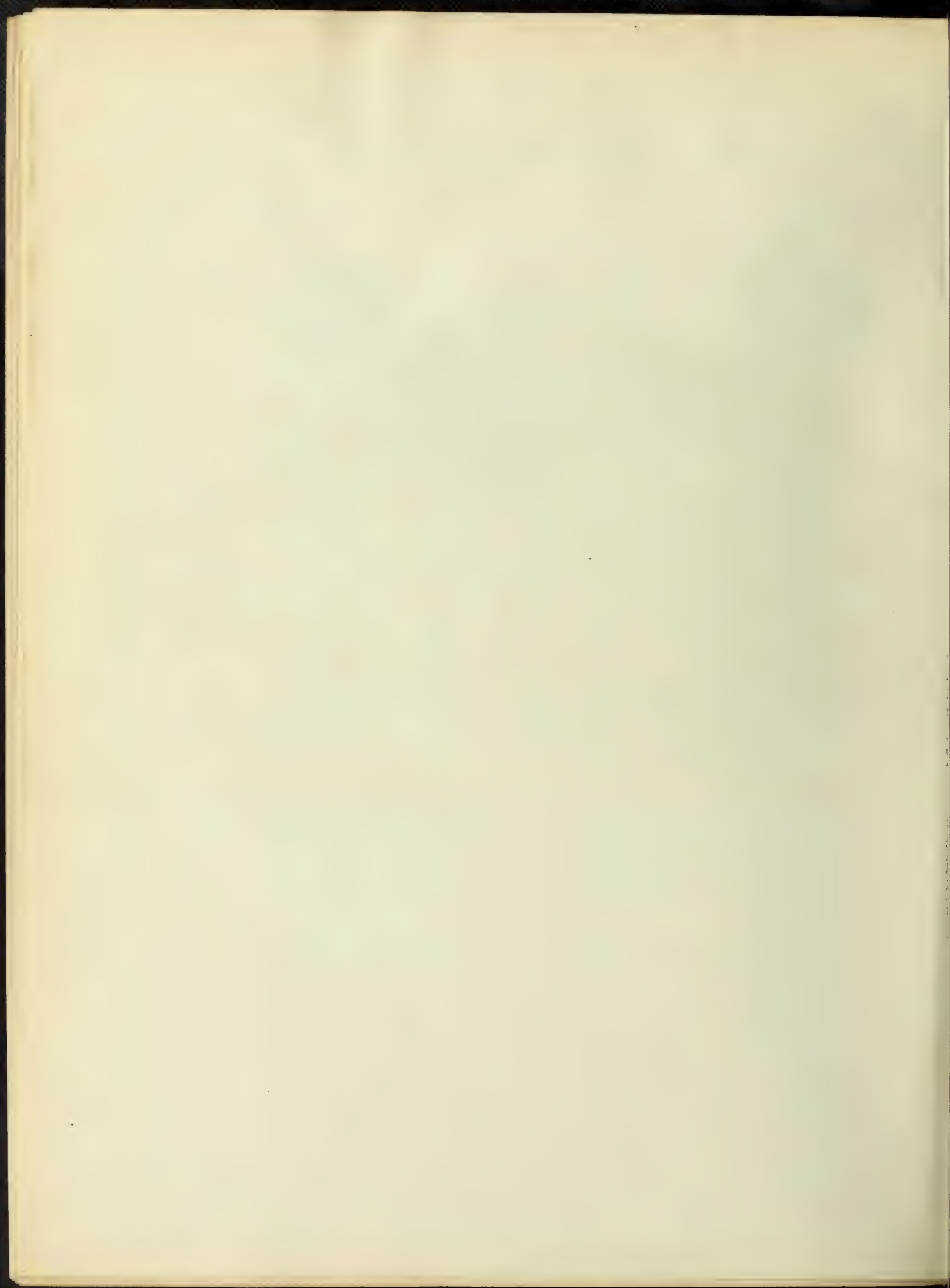
Prepare these solutions carefully, using chemically pure salts, and label each bottle.

*1000 cc. of distilled water  
to 1000 cc. of  
the distilled water.  
100 of each instead  
of 1000.*

*Taken from Hopkins and Pettit's manual  
of soil fertility. Only eight jars are used  
instead of ten.*









NONE

ALL BUT P

ALL BUT N

ALL BUT K

ALL

fig 7.

Series of corn showing effect of absence of any one plant food. Potting jars provided with drainage tubes as usual. In quantity 3 and 4 inches in diameter. The plant in it is a standard one selected.

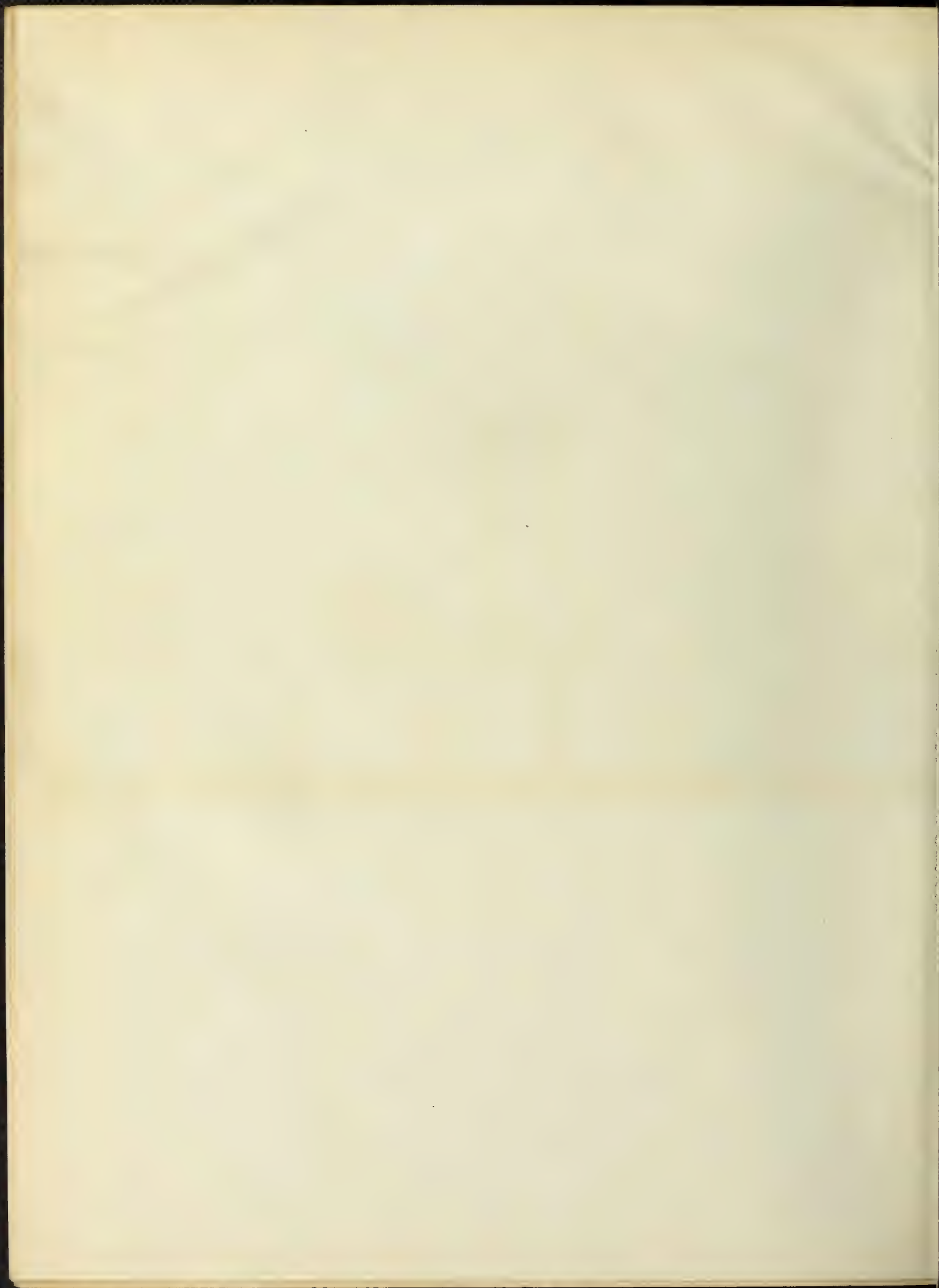




Fig. 3.

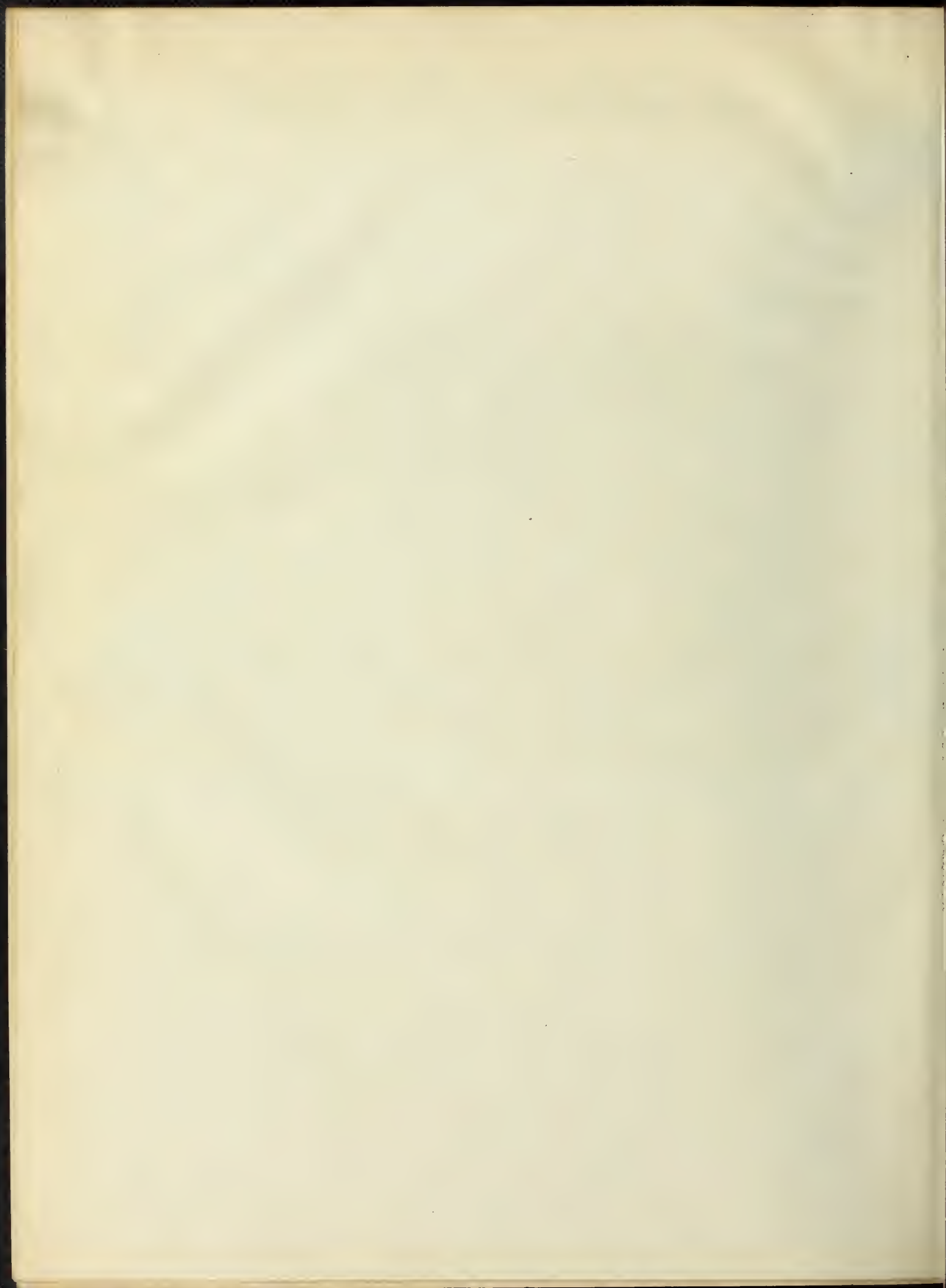
Some results of water and nutrient supply to plants  
 in a pot experiment. The plants are corn, and the  
 results show the effect of different nutrient supplies.





Fig 9.

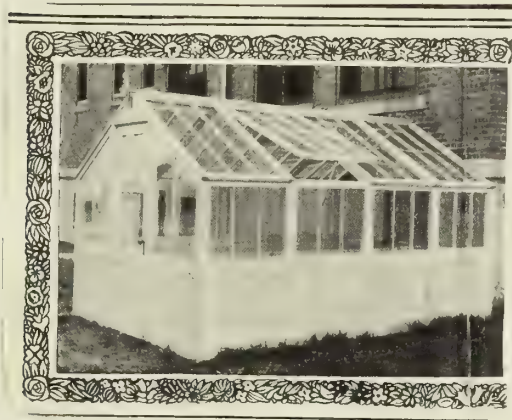
A similar series with a different type of  
 control. Kope is a representative type of  
 the *S. indicæ* (not *S. indicæ* as it is not a



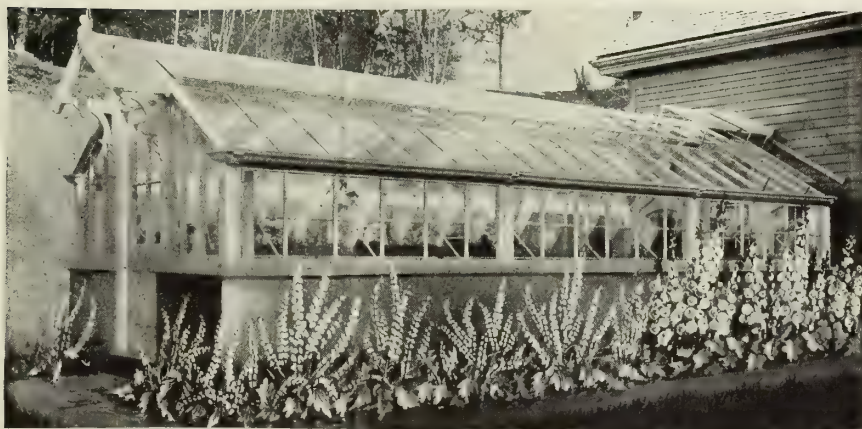




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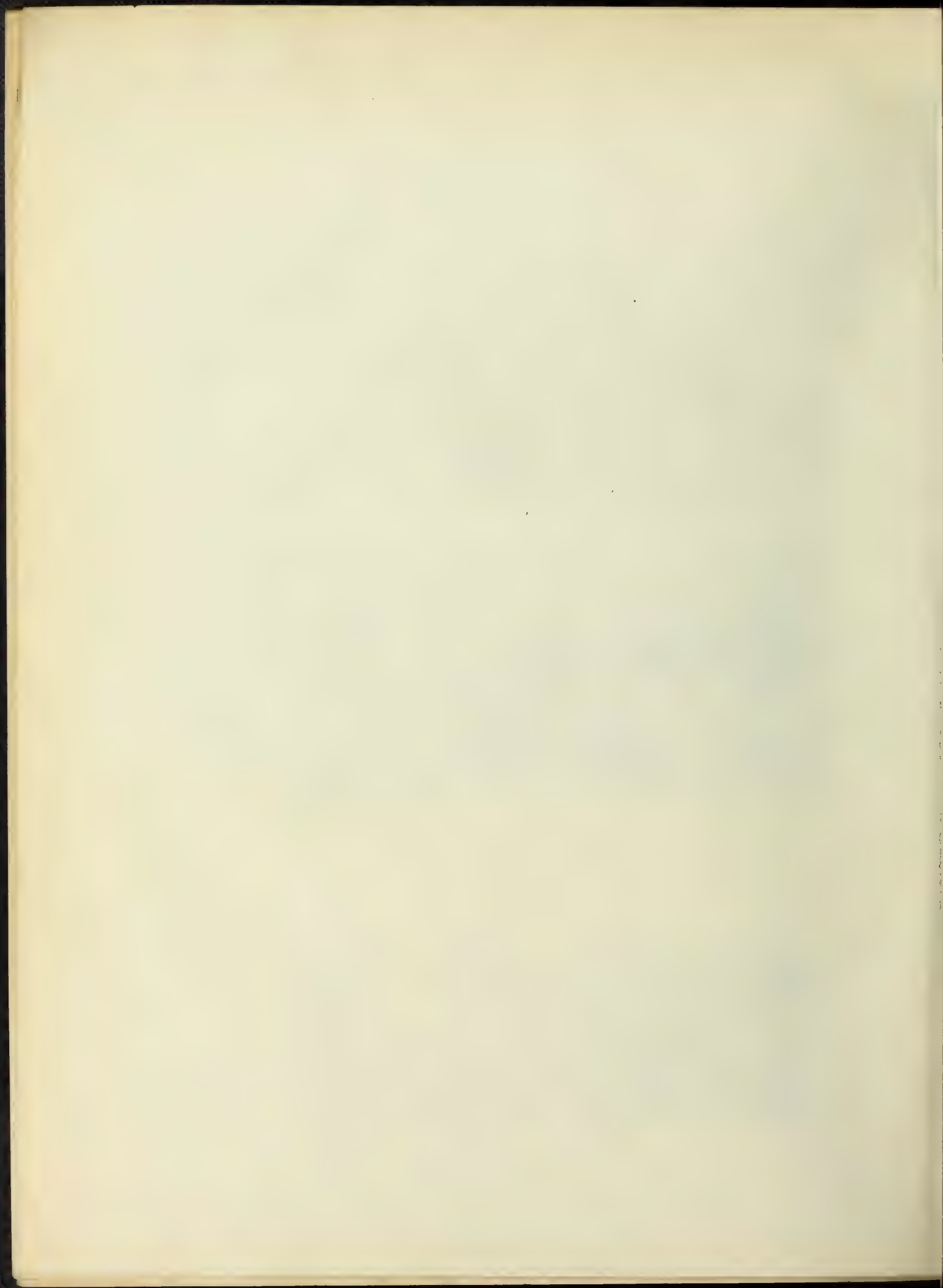


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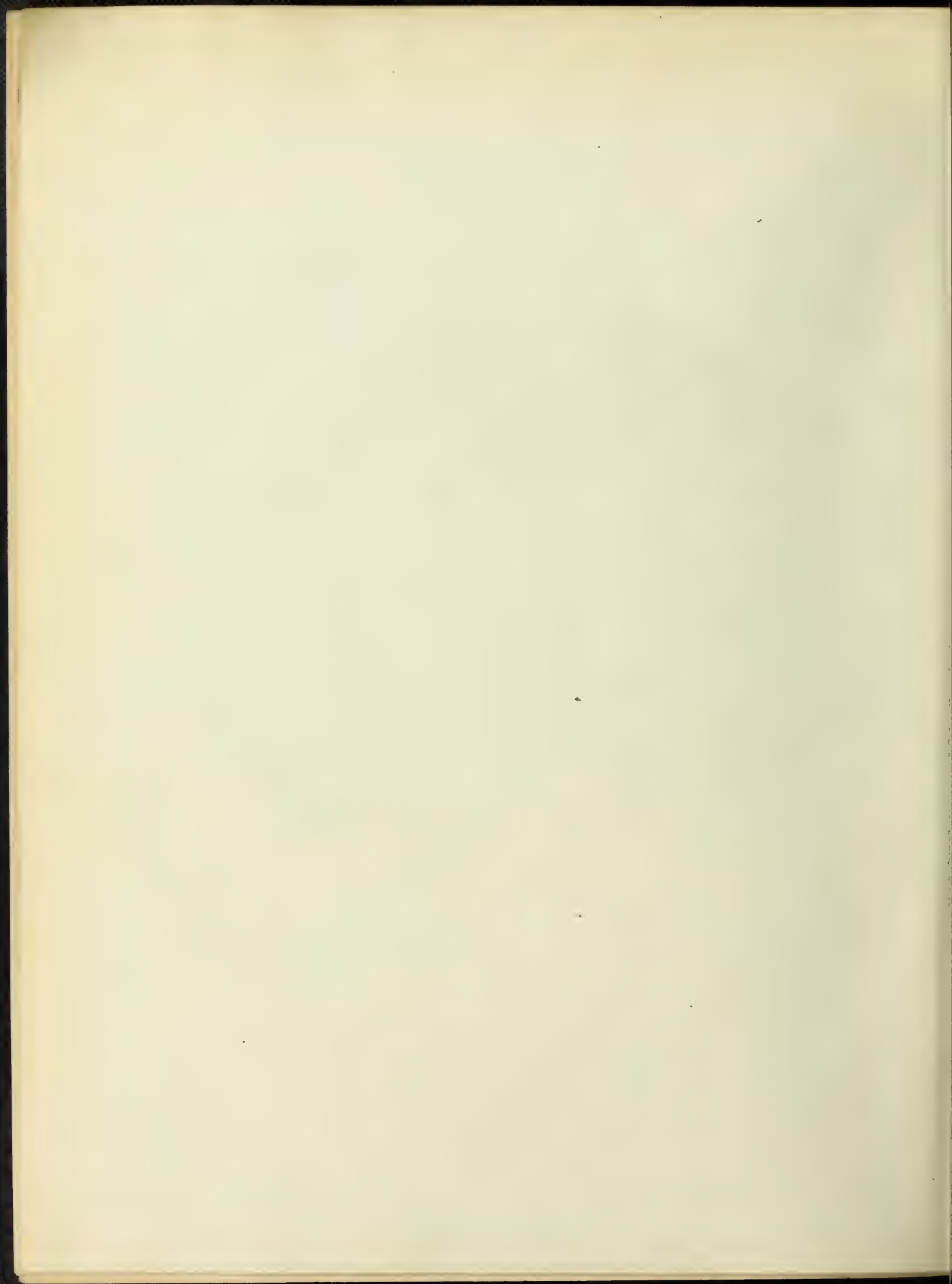


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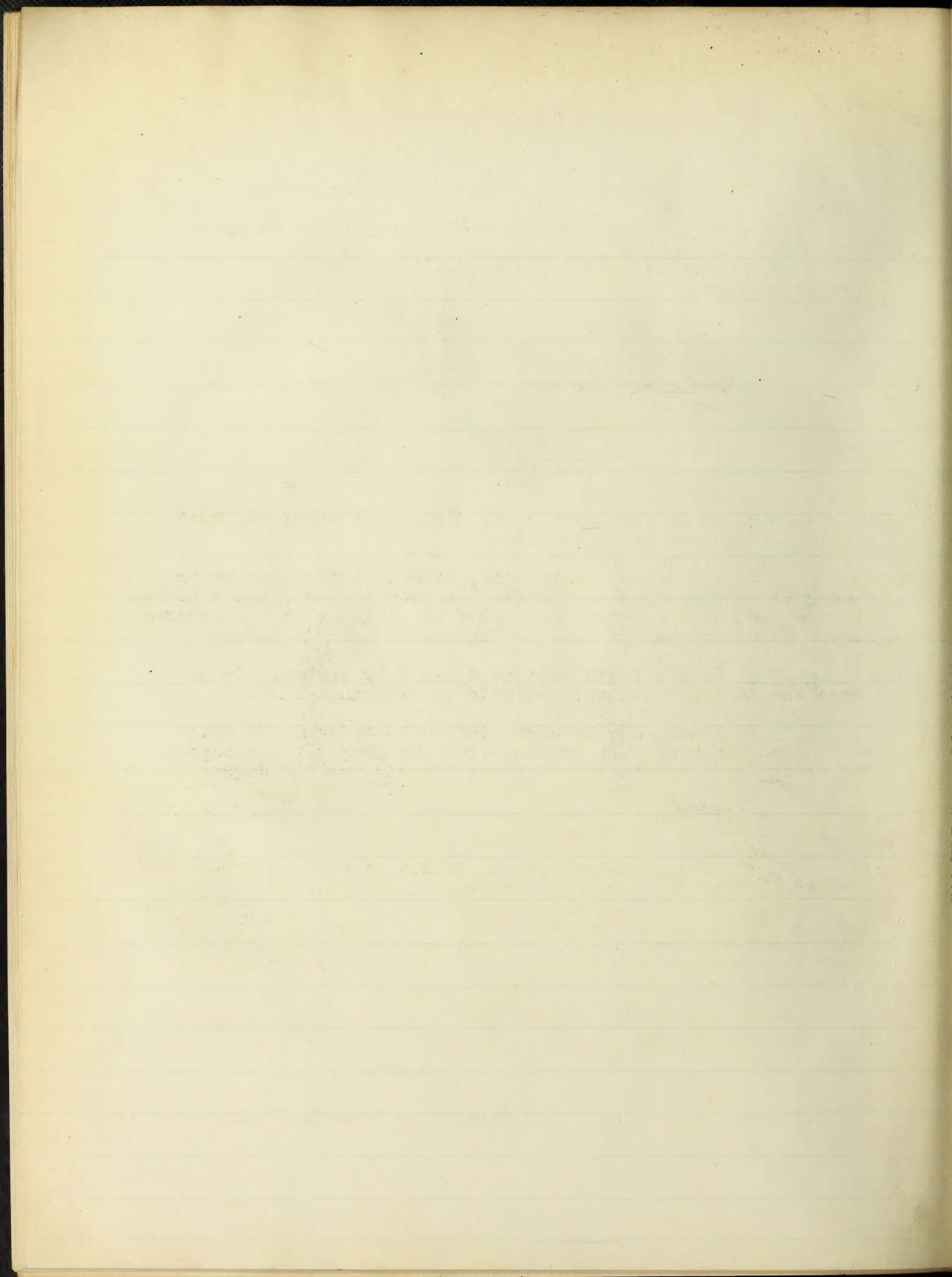
I have been thinking of you a great deal lately  
and wondering how you are getting on. I hope  
you are well and happy.

(2) I have been thinking of you a great deal lately  
and wondering how you are getting on. I hope  
you are well and happy.

(3) I have been thinking of you a great deal lately  
and wondering how you are getting on. I hope  
you are well and happy.







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Following are the Rules of the Council of  
Administration governing theses for bachelors' degrees:

1 The Title Page should be according to the following form:

(Title of Thesis)  
by  
(Writer's name)  
Thesis for the degree of \_\_\_\_\_ in (course)  
in the  
College of \_\_\_\_\_  
of the  
University of Illinois  
(Date)

2 It is strongly urged, though not required, that bachelors' theses be typewritten.

3 A printed certificate, signed by the instructor under whose direction the thesis has been prepared and approved by the head of the department, must be attached to each thesis. Blank forms may be obtained at the offices of the deans.

4 Theses paper must be 8 1/2 X 11 inches. In no case should the writing be outside the marginal line.

5 Theses may be presented in book form. In this case the thesis must be printed with the proper title page on which shall appear these words: "Thesis for the degree of \_\_\_\_\_ in the University of Illinois." Other use of the matter in the same form must not be made except by agreement or permission of the proper college faculty.

6 Theses manuscript, in condition for the press, the publication of which has been approved and provided for, may be accepted as fulfilling the thesis requirement for graduation on recommendation of the head of the department in which the work has been done, and on the assurance of the Dean of the college concerned that a printed copy of the thesis will be filed with the Librarian of the University.

7 All theses must be completed and in the hands of the Dean of the college concerned not later than four o'clock on June 1, 1910.

*E. J. Townsend*  
Secretary of Council of Administration

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